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Engineering News-Record

ebruary 28, 1935

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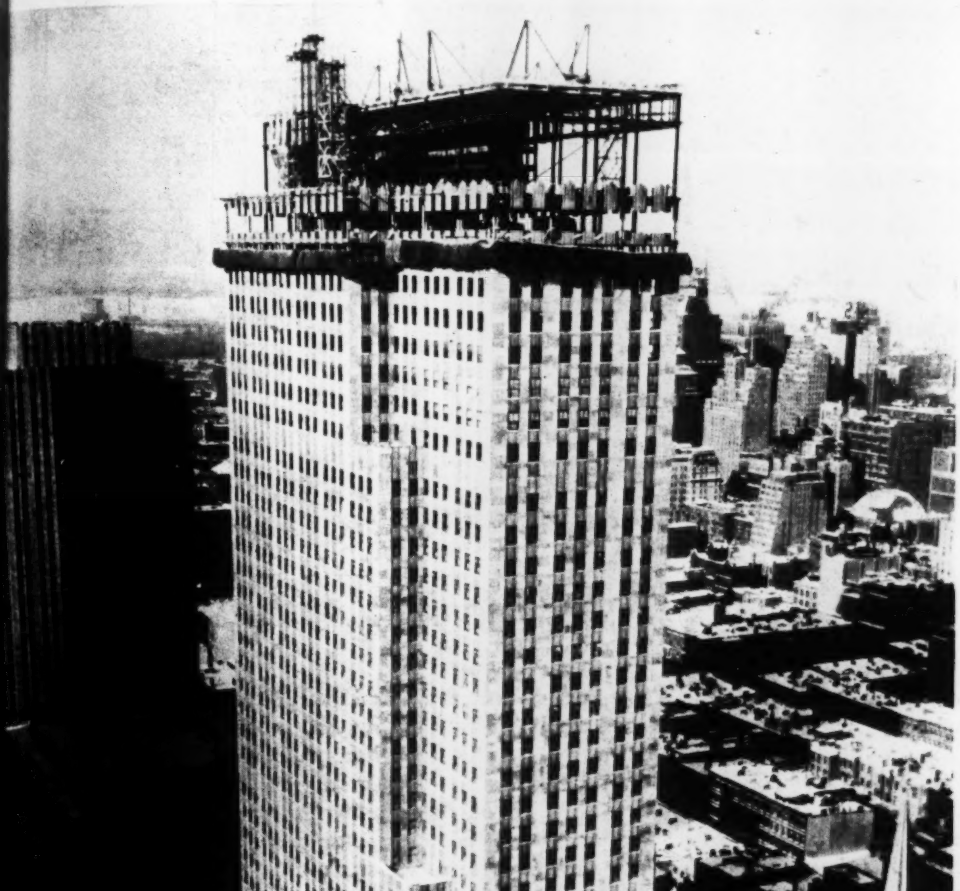

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A MOMENT WITH THE PUBLISHERS

Recovery *By Boycotting Employment?*

IT WOULD seem that during the last five years enough had been said to dispose of the fallacy that reversion to primitive methods can open the road to industrial recovery. Yet, now and then, it bobs up in quarters from which we expect more rational counsel.

Newspaper writers, for example, dwell on the vital necessity for reviving the durable goods industries; in the same issue they urge that public construction be so conducted as "to create the maximum amount of direct labor." Technically, the term "direct labor" covers those employed at the site of the work whether or not normal methods are employed. But unfortunately it is used and interpreted by many as implying primitive methods; i.e. using ten or twenty men to do by hand what one man could do by the normal use of the equipment provided by the skill and labor of other men in the mills and shops of industry. Some of these writers go so far as to advocate projects that "do not require large expenditures for materials."

TODAY it is generally acknowledged that the bulk of the unemployment is among the workers in durable goods, the very men who normally would find employment in producing and servicing construction materials and equipment. It is acknowledged, moreover, that further revival of the consumable goods industries must await the reemployment and restored purchasing power of those workers.

But the only way to put those men back to work is to foster demand for the products of their labor. For the time being, and until private construction is resumed on a more normal scale, the major market for those products is public construction; that is why the public works program was undertaken.

So we might expect general acknowledgment that public construction should be so conducted as to encourage the use of those materials and equipment, thereby conserving existing employment and stimulating additional employment in the durable goods industries.

But not so. These "hand-labor" counsellors tell us that we should use the public credit to provide subsistence doles rather than to foster useful employment. To each of the unemployed skilled workers of these industries they would offer a laborer's job at a subsistence wage. Neither is that all. They tell us that our recovery (?) program should boycott the very materials and equipment that are produced by the workers in these industries where resourceful employers have managed to keep them in jobs.

APPARENTLY the idea is that if we once can get all the durable goods workers on a subsistence dole and all their employers into the bankruptcy courts we shall thereby "lay a foundation for normal recovery." In other words, by reverting to such abnormal and primitive expedients we shall achieve a normal and prosperous revival.

In all Wonderland, Alice found nothing so grotesque!

It is quite evident that the preachers of such doctrins actually have little faith in them. Else we should see these editors scrapping their linotypes and power-presses in favor of hand composition and press-work in order to make more jobs for unemployed printers; we should see the business men and bankers who advocate such policies scrapping their typewriters, adding machines, conveyors and all the rest of their production equipment, so that they, too, may "make the work go farther."

BUT they know how absurd that would be, so they pick on construction as the subject of their efforts to prove that we can revive a twentieth-century industrial economy by scrapping its framework and reverting to eighteenth-century practice.

Today happily there is less of such misunderstanding than has prevailed hitherto. But in some circles it persists to embarrass those competent public officials who are responsible for public construction. These men know better; they want to make the funds entrusted to them count most heavily for true recovery and at the same time return the greatest value to the taxpayers who eventually must pay the bill.

And this they can and will do if only they are permitted to carry on their work without interference by those who are so preoccupied with relief out on the job that they forget the need for recovery throughout industry.

Willard Chevalier

ENGINEERING NEWS-RECORD

Published every Thursday. Vol. 114, No. 9. Price 25c. per copy. Subscription, domestic, Mexico, Central and South American countries, $5 per year. Canada, including duty, $7.50. All other countries, $9 a year or 36 shillings. Entered as second-class matter April 11, 1917, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U.S.A. Cable Address "McGrawhill, New York." Member A.B.P. Member A.B.C. Copyright 1935 by

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d Street, New York; 520 North Michigan Avenue, Chicago; 883 Mission Street, San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C.

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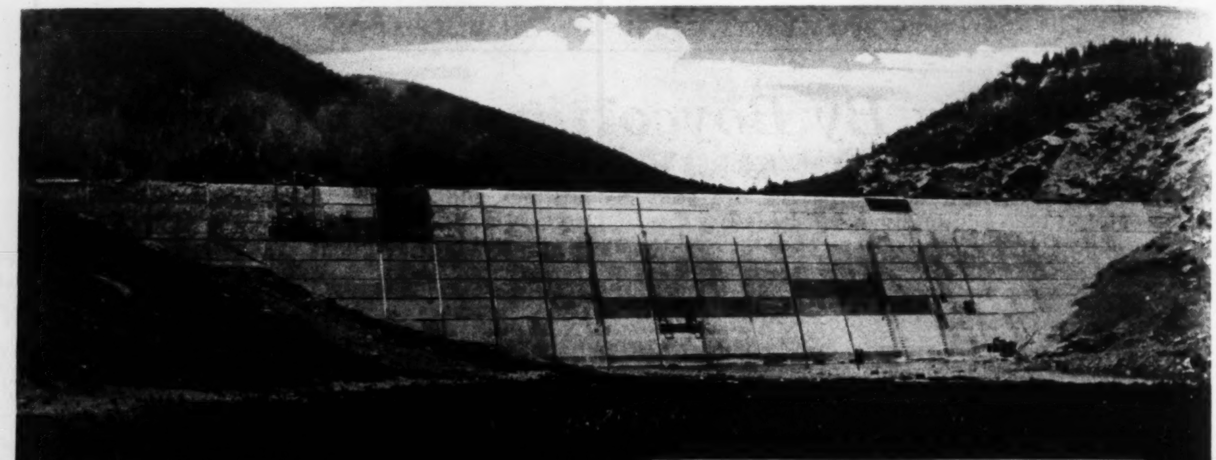
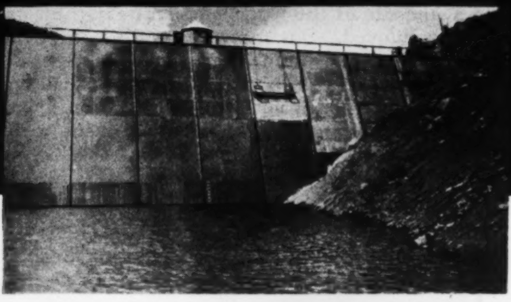


STEEL FACING protects EARTH-FILL DAMS



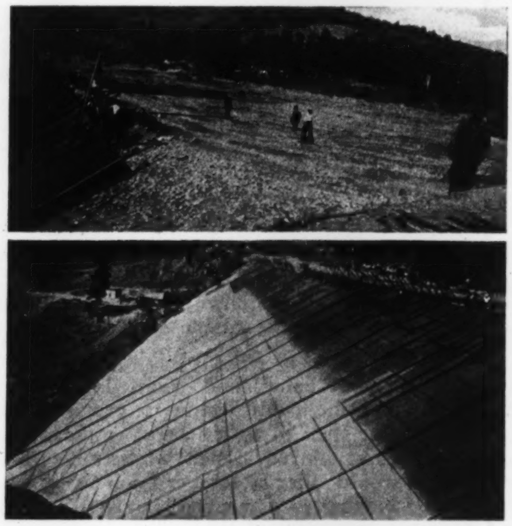
Two views, Penrose-Rosemont Dam, built for Broadmoor Hotel, Water & Power Co., Colorado Springs, Colo.—H. I. Reid, Consulting Engineer. Maximum height, 100 feet; crest length, 580 feet.

PERCOLATION and wave action as affecting gravel and rock-fill dams are dealt with by an unusual method in four recent American Bridge Company undertakings. To the upstream surface of the dam, steel plates are applied and so welded together, with specially devised expansion joints, that the whole facing becomes one continuous water-tight membrane of steel.

Of the four projects mentioned, one, the Penrose-Rosemont Dam, was finished in 1932; one, the El Vado Dam, will be put in service in 1935; the remaining two are now under construction.

The Penrose-Rosemont Dam is of rock-fill construction and has an upstream face wall of rubble masonry, to which the steel plates are securely anchored. The El Vado Dam is gravel-filled and the steel facing is applied directly to the upstream slope of the fill.

The resources and facilities of the American Bridge Company have always kept pace with every development and can be relied on to meet successfully any demand that may arise in the use of structural steel, for whatever purpose.



Two views, El Vado dam under construction, Middle Rio Grande Conservancy District, New Mexico—C. W. Howell, Chief Engineer, D. C. Henny, Consulting Engineer. Maximum height, 170 feet; crest length, 1200 feet.

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In the News:

A NETWORK of superhighways is reported to be part of the Administration's unannounced program for future work relief.

THE LAST BUCKET of concrete to form the main mass of Boulder Dam was placed on Washington's Birthday, concluding 21 months of unprecedented concreting operations during which 3,300,000 cu.yd. were placed. Conclusion of this work put the project a full 30 months ahead of original schedule.

MORE THAN $8,500,000,000 of possible public-works projects have been reported to the PWA in its national inventory of available work, which has been made as a preliminary to the coming program of the Administration.

THE ADVERSE DECISION of District Judge Grubb of the federal court on the hydro-electric power production and sale activities of the TVA has raised such important questions as to TVA activities that the case will be appealed to a higher court without delay.

SENATORIAL APPROVAL of the McCarran amendment to the $4,880,000,000 works bill, which would require the paying of prevailing wages on work-relief projects, caused the Administration to have the measure returned to committee for further study.

LEGISLATION which would create a Merrimack Valley Authority is to be introduced in the Massachusetts and New Hampshire legislatures following a conference of states and federal officials on the proposed $40,000,000 Merrimack Valley improvement project.

A $1,130,000 LOW-COST HOUSING PROJECT in Washington, D. C., has received preliminary approval, as announced by the FHA. The project is to be financed by a private loan.

In This Issue:

PROBLEMS in planning concreting facilities for the substructures of two Cape Cod Canal highway bridges 4 miles apart were solved by the contractor with the use of several batching plants and tip-over-body trucks delivering dry materials to paving mixers which moved from pier to pier at the sites.

THE INTEREST of the construction industry in the New Deal is broader than the most obvious feature of PWA financing, and such additional aspects as the CCC, mapping, forest improvements, soil-erosion control and others are outlined in the present article.

DOWELS have become one of the vital elements in the building of concrete pavements, and the present article discusses problems of spacing, shape, installation and costs.

THE NATIONAL GEODETIC-CONTROL NETWORK was increased 54 per cent in miles of leveling and 28 per cent in triangulation arc during the last seven months of 1934. The type of work carried out in this PWA-financed program is reviewed.

REINFORCED BRICK MASONRY SUBSTRUCTURE, facing and railings are the unusual feature of a small concrete-slab highway bridge built in Ohio. Idle brick plants near the site and the resulting employment benefit were factors in the plan.

GREATER STRENGTH AND TOUGHNESS and less absorption and abrasion of de-aired paving brick, as compared to ordinary paving brick, are the characteristics reported in a paper presented to the National Paving Brick Association, which is abstracted this week.

FOR TESTING the torsional strength of heavy I-beams and column section, a machine of 750,000-in.lb. capacity has been built at Lehigh University out of a standard comprehensive type of machine.

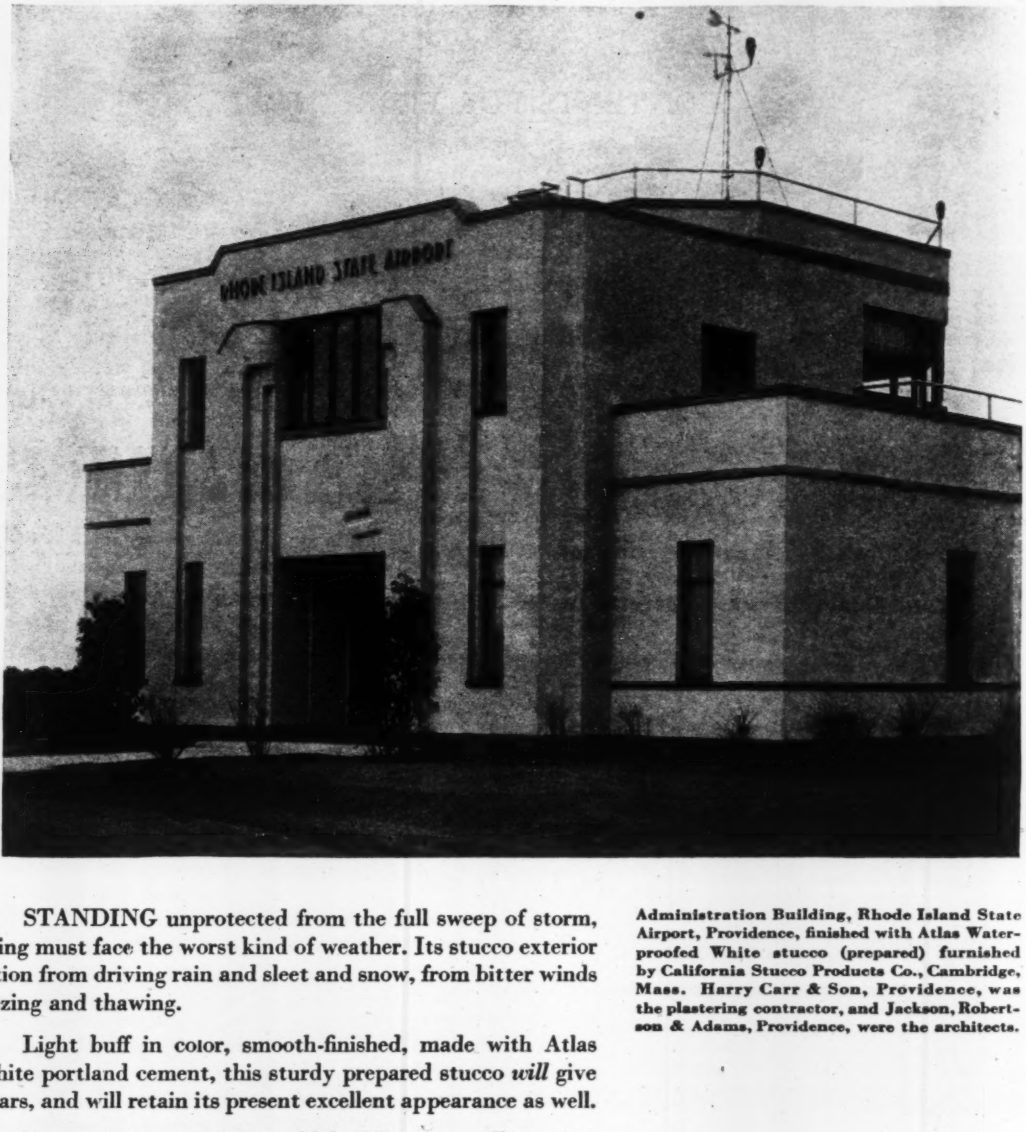
METHODS OF ROCK-DUST CONTROL in underground work as a prevention against silicosis, as discussed at the recent convention of the A.I.M.E., are reviewed.

THE AMERICAN CONCRETE INSTITUTE convention, held in New York last week, served to focus attention on the rapidly changing practices in concrete design and construction. Special cements, vibration, shell roofs, hinged arches and refined design were some of the items considered. Attendance was greater than in many years.

Coming Articles:

CONSTRUCTION of eight cofferdams for building locks in the Rock Island district of the upper Mississippi River navigation improvements gave opportunity for a study of the occurrence of seepage through sand bottom. By placing lines of gages across the cofferdam walls, seepage lines in sand fill were located. This interesting study is described and discussed by H. G. McCormick of the district engineering staff in an article to be published in our next issue.

At an Airport — STURDY STUCCO



Administration Building, Rhode Island State Airport, Providence, finished with Atlas Waterproofed White stucco (prepared) furnished by California Stucco Products Co., Cambridge, Mass. Harry Carr & Son, Providence, was the plastering contractor, and Jackson, Robertson & Adams, Providence, were the architects.

STANDING unprotected from the full sweep of storm, this airport building must face the worst kind of weather. Its stucco exterior must give protection from driving rain and sleet and snow, from bitter winds and constant freezing and thawing.

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February 28, 1935

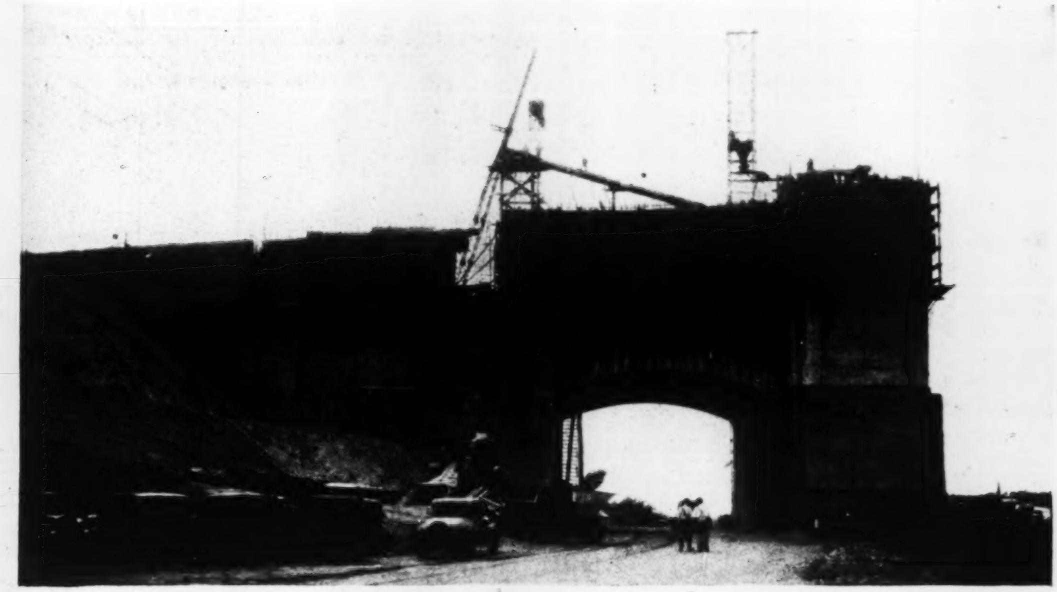


FIG. 1—CONCRETING the South Sagamore abutment with the plant units typical of the job—small tip-over-body trucks, paving mixers and a crawler crane to hoist the bottom-dump buckets. The elevator tower was required for the high pylons. Note how crane is set on an embankment to increase its reach.

Planting Bridge-Pier Work for Efficient Concreting

Demands for seal pours of 133 yd. per hour and irregular and small pours thereafter met by batching plants and pavers on a project involving two bridges over the Cape Cod Canal four miles apart

A FUNDAMENTAL QUESTION confronting the contractor who was awarded the substructure contract for the two highway bridges being built across the Cape Code Canal in Massachusetts was: What type of concreting facilities will most efficiently and economically meet the unusual demands of a 70,000-cu.yd. job involving a dozen land piers and abutments, some of which extend 100 ft. above the ground surface, on two bridges located 4 miles apart and where 4,300-cu.yd. continuous seal pours for each of the four piers at the water's edge must be made at an average rate of 133 cu.yd. per hour. Also two types of concrete, differing in mix proportions and in size of aggregates, might at times have to be furnished simultaneously. Two alternatives were studied: (1) a large central mixing plant with a fleet of agitator trucks and (2) several batching plants with small tip-over-body trucks delivering dry materials to mixers at the various pier sites. A theoretical economy was shown for the latter plan, and it was adopted. Paving mixers were chosen because of their mobility. For the same reason crawler cranes with 95-ft. booms were used to handle concrete into the high piers and abutments, although these had to be supplemented by hoist towers in one or two instances. With the work now completed, the contractor is well satisfied with the degree of efficiency obtained from this equipment and the method that was worked out for operating it.

The Cape Cod bridges (*ENR*, Jan. 25, 1934, p. 107, and Jan. 3, 1935, p. 1) for which the concreting facilities were developed are highway structures of continuous-truss type, providing a clearance of 135 ft. for canal shipping. They are located at the village of Sagamore near the east end of the canal and at the village of Bourne near the west end. Some 10,000 cu.yd. of concrete is also being supplied for the piers of the new railroad bridge at Buzzards Bay, but this is under a subcontract and did not figure in the original design of the concreting facilities.

Of the four possible locations for batching plants — North Sagamore, South Sagamore, North Bourne and South Bourne—plants were installed at all but North Sagamore, where there were no railroad facilities for receiving aggregate and cement.

At South Sagamore and South Bourne, sidings from the railroad that

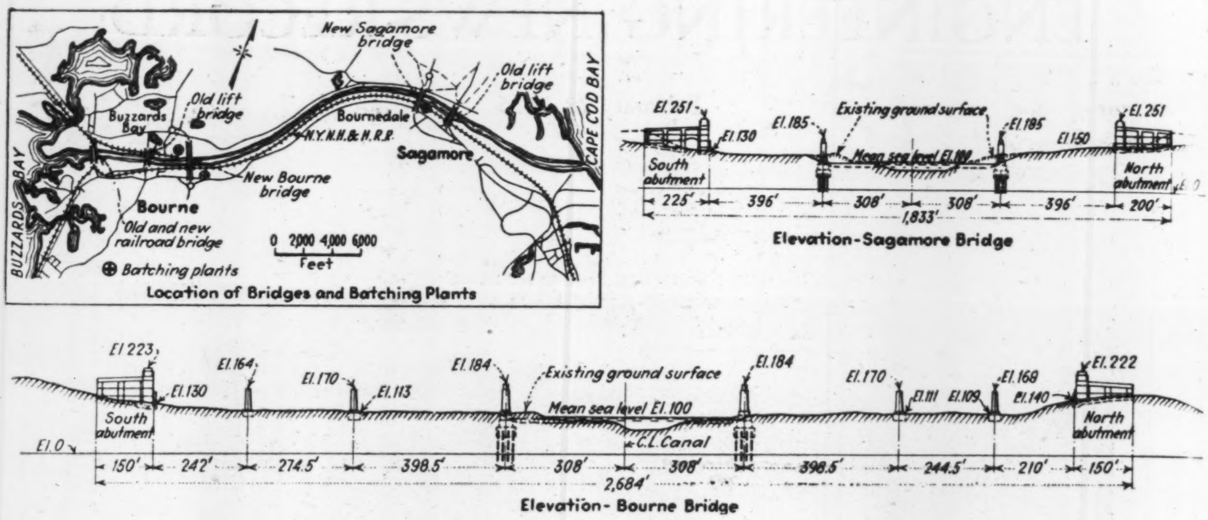

New Sagamore bridge
Old lift bridge
Bournedale
N.Y.N.H.&H.R.R.
Sagamore
CAPE COD BAY
Buzzards Bay
Old lift bridge
New Bourne bridge
Bourne
Old and new railroad bridge
BUZZARDS BAY
Batching plants
0 2000 4000 6000 Feet
Location of Bridges and Batching Plants
El. 251
El. 130
El. 185
Existing ground surface
El. 185
El. 150
El. 251
South abutment
Mean sea level El. 100
North abutment
El. 0
225'
396'
308'
1,833'
308'
396'
200'
Elevation-Sagamore Bridge
El 223
El. 164
El. 170
El. 130
El. 113
El. 184
Existing ground surface
El. 184
El. 170
El. 111
El. 109
El. 168
El. 140
El. 222
South abutment
Mean sea level El. 100
North abutment
El. 0
C.L. Canal
150'
242'
274.5'
398.5'
308'
308'
398.5'
244.5'
210'
150'
2,684'
Elevation- Bourne Bridge

FIG. 2—THE TWO BRIDGES four miles apart, as shown on the map, presented eight piers and four abutments for concreting, as shown on the elevations.

runs along the canal at these points were available. At North Bourne a mile of branch track was laid from Buzzards Bay to the batching-plant site. By placing a batching plant near each main pier, speed in handling materials to the mixers for the 4,300-yd. seal pours was assured, and the number of trucks required was reduced.

Batching plants

Each of the three batching plants followed the same general pattern, a typical layout of which is shown in Fig. 3. The two 100-ton bins were of three-compartment type, holding 40 tons of stone, 35 tons of sand and 200 bbl. of cement. A controlling reason for using two bins at each plant was the necessity at times of furnishing different mixes for Class A or B concrete simultaneously. Sand and stone, dumped into undertrack hoppers, were transported to stockpiles by an 18-in. electrically operated belt conveyor. Or this belt conveyor could be connected with the 20-in. belt conveyor that charged the bins. The charging belt also ran beneath two 70-ton hoppers into which stone and sand were transferred by crawler-crane buckets from the stockpiles. At the bin end of the charging belt, a swivel spout directed the aggregates into the stone or sand compartments as desired.

Cement was received in special hopper-bottom railway cars which were connected by canvas spouts to twin 10-in. screw conveyors under the tracks (with a 60-ton per hour capacity), which discharged into a 7x14-in. bucket elevator at one side of the bins. A gate at the top of the elevator permitted dis-

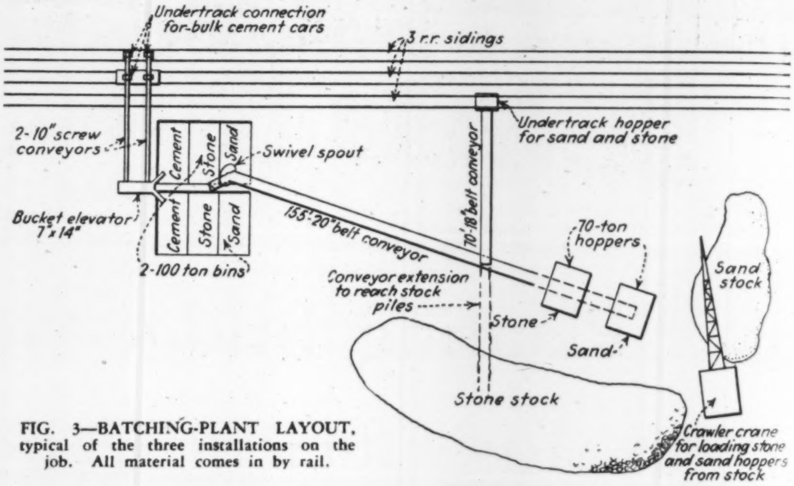

Undertrack connection for bulk cement cars
3 r.r. sidings
2-10" screw conveyors
Undertrack hopper for sand and stone
Cement
Stone
Sand
Cement
Stone
Sand
Swivel spout
Bucket elevator 7"x14"
155'-20" belt conveyor
70'-18" belt conveyor
70-ton hoppers
2-100 ton bins
Conveyor extension to reach stock piles
Stone
Sand
Sand stock
Stone stock
Crawler crane for loading stone and sand hoppers from stock

FIG. 3—BATCHING-PLANT LAYOUT, typical of the three installations on the job. All material comes in by rail.

FIG. 4—TWO VIEWS of the batching plant, whose layout is shown in Fig. 3. Left: aggregate-handling conveyors with railway car at extreme right and bridge superstructure overhead. Right: cement end of plant with bulk-cement cars on left-hand track.

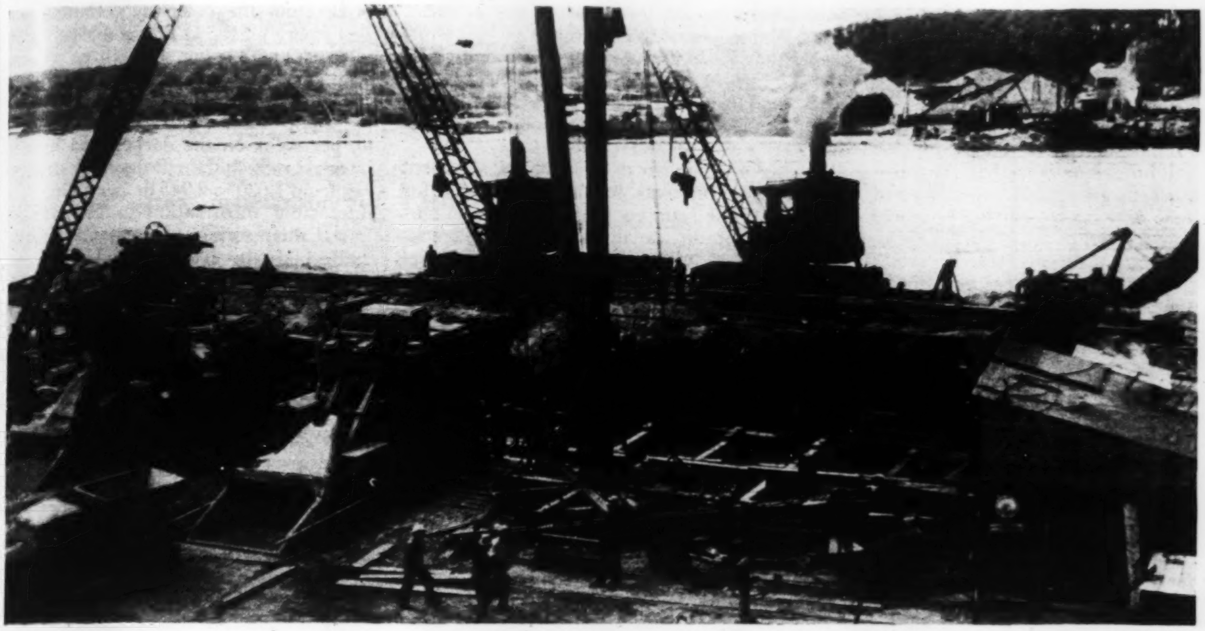


FIG. 5—BATTERY of five paving mixers making the 4,300-cu.yd. continuous pour on the seal course of the South Bourne main pier. The mixers discharged into bottom-dump buckets handled by the four derricks and cranes.

charge into the cement compartment of either bin. Such large-capacity cement-handling facilities were required because for each seal pour a total of 21 cars of cement was required in a period of about 32 hours. This is said to constitute one of the largest single shipments of bulk cement yet made in the eastern part of the country.

Batching was by weight, stone and sand going into the same weighing batcher, while a separate batcher was provided for the cement. The single-batch trucks were driven under the bins and loaded with stone, cement and sand in that order.

Seal concreting

At the main piers where the large seal pours were required a platform was built at one side of the cofferdam, to accommodate four 27-E pavers and a dual-drum mixer of the same size. Mixed concrete was chuted into the bottom-dump buckets of the subcontractor who built the bases of the main piers (Fig. 5). In making the 4,300-yd. continuous pours, two 2-yd. buckets and two 1-yd. buckets were used. For these pours seven of the single-batch trucks shuttled back and forth between the near-by batching plant and the pavers at the pier site.

This simple procedure in making the seal pours, which was used at both Bourne piers and at the South Sagamore pier, was not applicable to North Sagamore where there was no batching plant. To have trucked all of the materials in dry batches from South Sagamore around to pavers at North Sagamore would have required too large a number of trucks to meet the requirements of 133 yd. of concrete per hour for some 32 hours. Therefore, the usual procedure was supplemented by setting up a central mixing plant at South Sagamore near the batching plant, where a few dry-batch trucks would be adequate to serve it, and then to transport mixed concrete around to North Sagamore in large agitator trucks. Pavers were also set up at North Sagamore, and the remainder of the batch trucks brought dry materials to them as on the other seal pours.

The central mix plant layout was simple but effective. A convenient hillside provided an ideal location for a two-level layout. An elevated platform of timber was constructed for the charging and mixing floor. On this platform two paving mixers were set, so that they could discharge over the edge of the platform into the agitator trucks on a road at the lower level. A roadway was built to the platform level, and over this the small trucks from the batching plant brought in the dry materials for the pavers. On the seal pour for the North Sagamore pier five 4-yd. agitator trucks, six 4-yd. dry-batch trucks and twelve 1-yd. dry-batch trucks were used to transport concrete and dry materials. The round trip required about half an hour.

Pier and abutment concreting

For the work above ground, concreting demands were less severe, but the

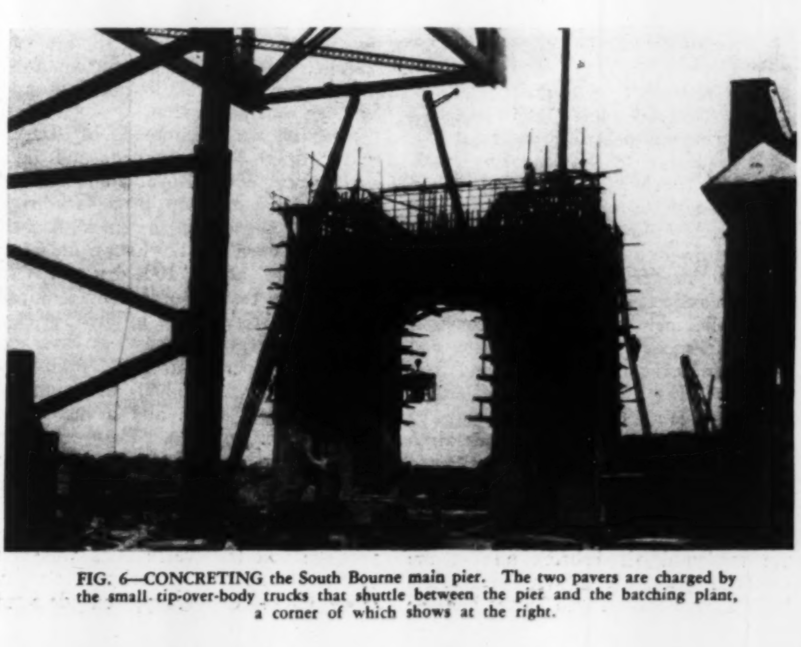


FIG. 6—CONCRETING the South Bourne main pier. The two pavers are charged by the small tip-over-body trucks that shuttle between the pier and the batching plant, a corner of which shows at the right.

handling of forms and reinforcing and the separation of operations into groups at each pier and abutment site added new complications. Mobility of the pavers and of crawler cranes provided the principal element that contributed to the success of this work. Another helpful factor was that the reinforcing steel in the shafts of the main piers (the only ones requiring reinforcement) was formed of structural shapes, on the recommendation of the contractor. This permitted the reinforcing to be set with a minimum of difficulty and hazard and also offered a substantial support from which the forms could be hung and adjusted.

Concreting on these piers and abutments was handled as it was for the bases of the main piers. Pavers placed near the work were charged from the batch trucks and discharged into bottom-dump buckets handled into the forms by the crawler cranes. The small trucks with tip-over bodies proved very effective in negotiating steep grades and loose-fill roads. For most of the work the 95-ft. booms of the cranes were of ample length, but on the highest parts of the piers and particularly on the pylons of the abutments the booms were too short when the cranes were at ground level. Accordingly, the cranes were run up on embankments of earth, sometimes of considerable height, while the mixer remained at ground level (Fig. 1). In one instance, however, the height was so great (about 130 ft.) that the cranes were supplemented by an elevator hoist and chutes.

On the North Sagamore abutment concreting was handled as it was for the seal pour on the main pier on this side of the canal. The agitator trucks charged with concrete at the central plant at South Sagamore delivered to cranes and buckets at the site.

Administration

The Cape Cod Canal bridges are being built under the supervision of the Corps of Engineers, of which Lt.-Col. John J. Kingman is Boston district engineer. Designs for the highway bridges were prepared and construction is being supervised by Fay, Spofford & Thorndike, consulting engineers, Boston. The contractor for the substructure work, for which the concreting facilities described in this article were developed, is the P. J. Carlin Construction Co., New York; J. P. Carlin is president, Samuel Kent chief engineer, Sylvia Bonelli superintendent, M. T. Staples resident engineer, and Paul Jones expediter.

Properties of De-Aired Brick Revealed by Tests

Investigations reported to National Paving Brick Association indicate greater strength and toughness and less absorption and abrasion for de-aired brick compared to ordinary paving brick

By **R. B. Keplinger**
Metropolitan Paving Brick Co., Canton, Ohio

EQUIPMENT for producing de-aired brick has been installed during the past three years at five of the plants of the company with which the writer is connected. The first strength tests were made in the fall of 1932 on brick selected from those manufactured by the first de-airing extrusion machine installed at the Imperial plant. The averages ran from 12,446 lb. per sq.in. and absorption of 7.47 per cent for the lighter-burned brick, to 19,575 lb. per sq.in. and 3.66 per cent absorption for the harder-burned brick. These results may be fairly compared with brick not de-aired from the No. S6 plant, which showed an average compressive strength of 11,686 lb. per sq.in. and 4.55 per cent absorption. Some brick selected from the rattled de-aired brick pile at the Imperial plant, which was the hardest-burned, was broken into halves and the fractures examined, to select specimens showing the best interior structure and texture; these samples gave a compressive average of 17,823 lb. per sq.in. and 1.36 per cent absorption.

Selection was then made of sixteen bricks, dried but unburned, and they were taken to the Royal plant, set six courses from the top in a face-brick kiln and burned in a smoke-flashed face-brick burn for 120 hours, finishing the kiln at about 100 deg. F. less temperature than is ordinarily required for paving brick. Five of these bricks, tested compressively, gave an average of 23,774 lb. per sq.in. and 2.70 absorption, with an individual minimum of 17,875 lb. per sq.in. and a maximum of 26,062 lb. per sq.in. These tests are cited as an indication of a possible optimum point in heat treatment, for high compressive strength.

In October, 1934, a series of compressive and transverse tests was run at the engineering experiment station, Ohio State University, on de-aired brick from the company's Canton and Bessemer plants. These bricks were selected and arranged in three groups, light, medium and dark. The average crushing strengths ran from 11,540 lb. per sq.in. on a light sample to 17,800 lb. per sq.in. on the darker and harder-burned brick, and the transverse strength ran from 1,620 to 2,945 lb. per sq.in. The interesting information to be gathered from this series of tests was that while both the crushing and transverse strengths increase more or less consistently, directly as the hardness of burn, it was impossible to correlate the two tests. Quite frequently, a specimen showing high compressive strength would show a lower transverse, and vice versa. It should be added that these samples in the medium and dark ranges were considerably lower in absorption than the samples selected in 1932, showing average absorptions as low as 0.48 per cent, with an individual minimum of 0.23 per cent. This was due to higher vacuums obtained in extrusion and not to greater severity in heat treatment. Here again is a faint indication that a possible optimum vacuum point has been reached and passed for these particular properties, in certain groups.

Quite recently, Dr. Reuckel, of the brick research bureau, collaborating with Mr. Litehiser, head of the Ohio state highway testing laboratory, has begun an investigation into the tensile and compressive strength of paving brick, both de-aired and otherwise, together with rattler and other possible abrasion tests. A glance over the results as tabulated (*ENR*, Feb. 14, 1935, p. 293) indicates that apparently some manufacturers have not standardized de-airing operations sufficiently. Second, there is apparently no possible correlation of rattler tests with flexure tests. And, finally, not only did the highest flexure test, both average and maximum, occur on an unde-aired product but also this same product, owing to some laminated samples, showed a 26.55 per cent loss when subjected to the standard rattler test.

Three de-aired paving-brick samples, ranging from medium to hard-burned, tested in the Deval rattler gave an average of 3.15 per cent wear and an average French coefficient of 12.77. Cores from similar samples tested on the Page impact machine gave an average toughness value of 12.33. Another test, using the Deval rattler and two samples of de-aired paving brick, resulted in an average of 2.78 per cent of wear and 14.45 French coefficient. Standard specifications for granite block require for heavy traffic a percentage of wear of not more than 3.6, a French coefficient of wear not less than 11 and toughness not less than 9.

These tests were made on selected bricks and over a very short burning range, so that they are far from being representative of a commercial shipment.

Improved Street Lighting Reduces Night Accidents

Count of night-traffic accidents for nine months before and after installation of better street-lighting system in Evanston, Ill., shows reduction in accident frequency following improved lighting

By Edward W. Preston
Consulting Traffic Engineer, Chicago, Ill.

THE CITY of Evanston, Ill., offered an excellent opportunity for a study of the effect of street lighting on night accidents when a new street-lighting system was installed in October, 1932. The writer made such a study under the direction of Earl J. Reeder, traffic engineer of the National Safety Council and former traffic engineer of Evanston, Ill., and with the cooperation of Franklin M. Kremel, who is director of the accident-prevention bureau of the Evanston police department.

Night and day accidents

A comparison of the night and day accident experience was made for corresponding periods during the old and new lighting systems. The study was started Nov. 1, 1932, when all the units of the new system were in operation, and it was continued for nine months. Data were obtained for the previous period starting Nov. 1, 1931, from the accident report cards. Tables I, II and III give the results of this preliminary study and show the actual accident experience and percentage reductions. Such a comparison makes no allowance for varying weather and road-surface conditions, and the results would not necessarily indicate that all the reduction in night accidents was due to improved street lighting.

According to recent studies, 83.3 per cent of the traffic accidents occur during clear weather, 5.0 per cent during cloudy weather, 10 per cent during rainy weather and 1.1 per cent during snowy weather. It is also estimated that 81.4 per cent of the traffic accidents occur when the road surface is dry, 15.6 per cent when wet, and 3.0 per cent when icy.

Basis of comparison

We can compensate to a large extent for the varying weather and road-surface conditions and can arrive at a basis of comparison if we assume that the same ratio existing between the day and night accidents of the period during the old lighting system exists also between day and night accidents of the period during the new lighting system. Let this basis of comparison be called the anticipated number of night accidents. The actual number of night accidents occurring under the new lighting system is compared with this anticipated number of night accidents in order to get the percentage reduction occasioned by the improved street lights.

During the investigation I calculated monthly reductions. Table IV is a summary of these monthly reductions for the nine-month period. In this table "Before" and "After" refer to the periods before and after the installation of the new street-lighting system. Since the accidents resulting in death were too few to be significant, they are listed with those resulting in personal injury. During the period of the old lighting system there were seven fatalities, four of which resulted from night accidents. After the installation of the new lighting system there were three fatalities, two of which resulted from night accidents. It is to be understood that the figures in the tables indicate the number of accidents and not the number of persons injured or killed; for example, 80 in Table IV means the number of traffic accidents that resulted in personal injury or death.

TABLE I—RECORD OF ACCIDENTS RESULTING IN PERSONAL INJURY AND DEATH AT EVANSTON, ILL.

November 1931 Through July, 1932 (Old Lighting System)
November 1932 Through July, 1933 (New Lighting System)

	—Old System—		—New System—	
	Day Accid'ts	Night Accid'ts	Day Accid'ts	Night Accid'ts
Nov.	20	16	11	12
Dec.	12	27	12	16
Jan.	7	18	13	5
Feb.	8	5	5	10
March	9	7	13	7
April	13	10	12	12
May	13	8	24	3
June	15	5	14	7
July	16	8	16	8
	113	104	120	80
Total	217		200	
Per cent of total	52	48	60	40
Per cent reduction of total accidents resulting in personal injury or death for the period of the new lighting system over the old				7.8
Per cent increase in day accidents				6.2
Per cent reduction in night accidents				23.3

TABLE II—RECORD OF ACCIDENTS RESULTING IN PROPERTY DAMAGE AT EVANSTON, ILL.

November 1931 Through July, 1932 (Old Lighting System)
November 1932 Through July, 1933 (New Lighting System)

	—Old System—		—New System—	
	Day Accid'ts	Night Accid'ts	Day Accid'ts	Night Accid'ts
Nov.	31	40	22	32
Dec.	40	45	54	28
Jan.	24	30	25	29
Feb.	42	25	49	18
March	48	23	31	23
April	41	24	41	27
May	58	15	43	13
June	70	12	63	17
July	36	19	47	8
	390	233	375	195
Total	623		570	
Per cent of total	62.5	37.5	65.8	34.2
Per cent reduction of the total accidents resulting in property damage for the period of the new lighting system over the old				8.5
Per cent reduction of day accidents				3.85
Per cent reduction of night accidents				16.3

For the "after" period there was an increase of 6.2 per cent in day accidents and a decrease of 27.9 in night accidents resulting in personal injury or death (the deaths were so few that they were insignificant) over the "before" period. There was a 3.85 per cent decrease in day accidents and a 12.9 per cent decrease in night accidents resulting in property damage over the "before" period. For total accidents there were a 1.59 per cent decrease in day and a 16.9 per cent decrease in night accidents. These results show very definitely that improved street lighting reduced night-traffic accidents in Evanston.

Ratio of accident decrease

It is a well-known fact that night accidents decrease as the per-capita cost of street lighting increases, and conversely. With the installation of the new lighting system, Evanston's per-capita cost of lighting increased from

TABLE III—RECORD OF TOTAL ACCIDENTS AT EVANSTON, ILL.

November 1931 Through July, 1932 (Old Lighting System)
November 1932 Through July, 1933 (New Lighting System)

	—Old System—		—New System—	
	Day Accid'ts	Night Accid'ts	Day Accid'ts	Night Accid'ts
Nov.	51	56	33	44
Dec.	52	72	66	44
Jan.	31	48	38	34
Feb.	50	30	54	28
March	57	30	44	30
April	54	34	53	39
May	71	23	67	16
June	85	17	77	24
July	52	27	63	16
	503	337	495	275
Total	840		770	
Per cent of total	60	40	64	35
Per cent reduction of total accidents for the period of the new lighting system over the old				8.35
Per cent reduction of day accidents				1.59
Per cent reduction of night accidents				18.4

TABLE IV—ACCIDENT EXPERIENCE UNDER THE OLD AND NEW LIGHTING SYSTEMS EVANSTON, ILL.

November 1931 Through July, 1932 (Old System)
November 1932 Through July, 1933 (New System)

	Day Accidents		Reduction in Per Cent	Night Accidents			—Reduction—
	Before	After		Before	Anticipated After	After	in Per Cent
Accidents resulting in personal injury and death	113	120	6.20	I 104	111	80	27.9
Accidents resulting in property damage	390	375	3.85	233	224	195	12.9
Total accidents	503	495	1.59	337	331	275	16.9

Note: the letter "I" means an increase.

$0.93 to $1.46. Unfortunately I was unable to obtain the initial costs of the old and new systems; but Table V, which I compiled from information supplied by Charles Bartlett, mayor of Evanston, will give the reader some conception of the comparative costs of the old and new lighting systems.

TABLE V—COMPARATIVE COSTS OF EVANSTON'S OLD AND NEW LIGHTING SYSTEMS

	Old	New
Energy (street lights)	$46,397.52	$52,254.23
Energy (stop and go lights)	3,000.00	3,000.00
Lamp renewal and supplies	Note	27,902.02
Auto equip. and maint	9,100.00	9,100.00
Total	58,497.52	92,256.45
Cost per capita	0.93	1.46

Note: This figure was not supplied.

No city can afford to reduce street-lighting expenditures. The result of such economy is invariably an increase in night-accident experience. Although 80 per cent of the traffic is in the day-time, nearly 50 per cent of the fatal traffic accidents occur during the hours of darkness.

Wtih automobile accidents increasing at an alarming rate throughout the country, there should be increased and not decreased budgets for street-lighting expenditures and accident prevention, as the Evanston studies clearly indicate.

Torsion Testing Machine of 750,000-In.-Lb. Capacity

By **Bruce Johnston**

Instructor in Civil Engineering, Columbia University

During the past year a torsion-testing machine of 750,000-in.-lb. capacity was built at the Fritz Engineering Laboratory of Lehigh University, to test the torsional strength of heavy I-beam and column sections. This torsion rig was used for tests of beams with either fixed or free ends and of lengths varying from $1\frac{1}{2}$ to 6 ft. The set-up was for 6-ft. lengths.

The manner of operation of the apparatus is illustrated below. The wire rope that applied torque to the sheaves and test beams was attached, as shown, to two I-beams. These I-beams crossed at the center and carried the load in the wire ropes to the head of a standard four-screw testing machine of 300,000-in.-lb. capacity. When the moving head of the machine was lowered, the two sheaves were caused to rotate in opposite directions, and the total load in the two cables (less the dead weight of the apparatus) was measured on the balance beam in the usual manner. The torsional load on the test beam was equal to the tensile load in one cable multiplied by the distance between cable centers, neglecting friction and bending of the cable, which were relatively small compared with the loads used. The cables were stressed up to about half their breaking strength.

For tests of light beams the load was applied by means of $\frac{5}{8}$-in. wire ropes that gave a capacity of about 300,000 in.-lb. The lighter cable was better for these tests because of its greater flexibility and ease of handling. For the tests of heavier sections, a 1-in.-diameter wire rope was used, giving the machine its maximum capacity of about 750,000 in.-lb.

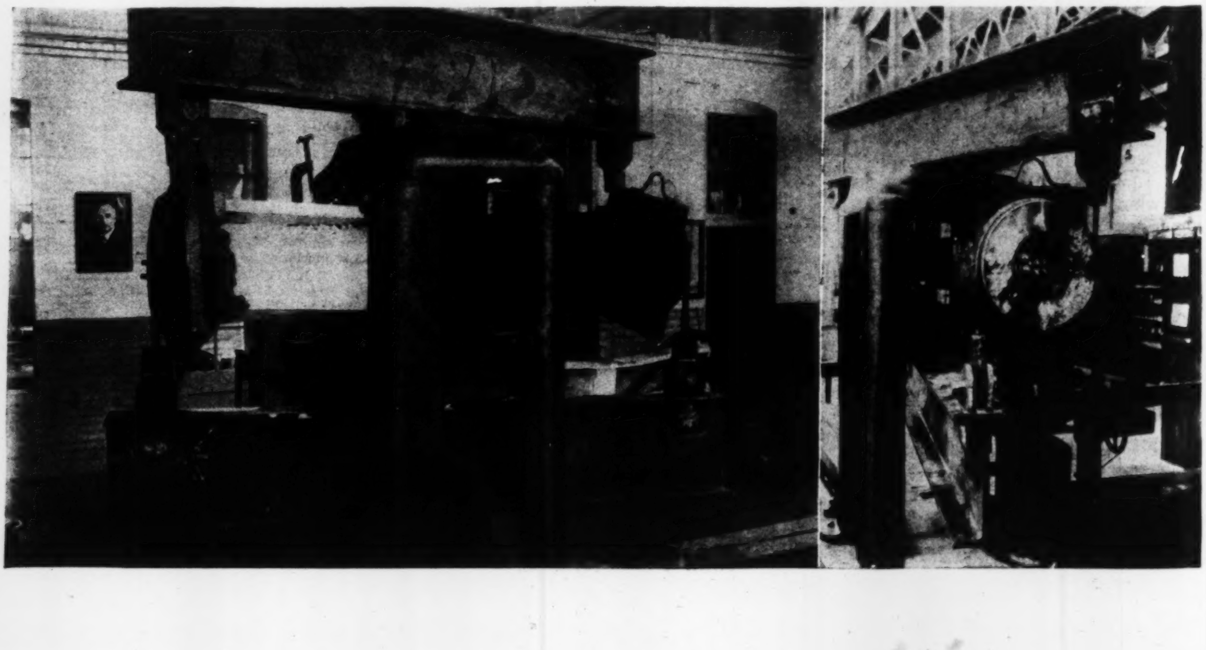
The sheaves were turned out of a 2-in. steel plate and were grooved to seat a 1 in. cable. The diameter of the sheaves at the root of the groove was 17 in. Through one of the sheave diameters a $1\frac{1}{8}$-in. hole was bored, and at the outer ends this hole was cut away on one side to meet the cable seat. This construction allowed the wire rope to pass continuously halfway around, through and then back around the other half of the sheave, thus giving reversal of action on the center line of the sheave. Two cable clamps, attached as shown, prevented slippage of the rope during the setting up of the apparatus. The sheaves were welded to 2-in. rectangular plates, tapped to receive bolts passing through the end plates of the test beams.

The loading beams (15-in., 82-lb. I's) were 8 ft. long and were supported at the center on a 2-in.-diameter round rocker bearing. The flanges were slotted at each end on either side of the web, to allow passage of the connecting plates. These plates were bored to receive the cable-socket pins. The cable sockets were made by bending a $1\frac{1}{4}$-in. square reinforcing bar and then welding on side plates. These sockets took a total load of 40,000 lb. in the cable.

The torsion machine operated very satisfactorily. During tests the apparatus was in such a state of balance that the loading beams could easily be tilted on their center roller bearing after a heavy torsional load had been applied to the test specimen.

The loading beams, sheaves and cable sockets were built in the Fritz Engineering Laboratory, which is under the supervision of Inge Lyse. With the exception of the cables, the material for the machine was supplied through the cooperation of the McClintic-Marshall Corp., Bethlehem, Pa.

TORSION-TESTING RIG, showing side and end views of the loading and twisting apparatus.



Construction's Stake in New Deal Activities

Aside from normal public work financed by the PWA, the development of PWA theories relating to resource conservation, land use, decentralization of population and housing, all have an important bearing on the construction industry

NOTHING ELSE in the New Deal's ambitious program of economic and social reformation is conceived on a grander scale than the plans to conserve and reconstruct the country's natural resources for the continuing benefit of the people. Considered in their bewildering entirety, the methods of broaching this huge undertaking still are tentative. Their immediate effect, in addition to creating employment to make up for the stagnation of private enterprise, was to provide more liberal support for regular and newly created agencies which staked out small fields of activity within the bounds of a distended budget.

Many of these activities generically are related to public works. Control of soil erosion, reclamation of submarginal land and reforestation, all of which operate to conserve watershed assets, are primary measures that prepare for subsequent engineering operations in flood control, power, water supply or navigation. Obviously, the primary activities can be extended indefinitely. They furnish, consequently, a broad field of employment.

CCC Is Labor Pool

An elementary conservation activity that may be greatly expanded in the coming work-relief program was organized in April, 1933, as the Civilian Conservation Corps. Approximately 360,000 men from 18 to 25 years old, previously on relief rolls, plus a few World War veterans and Indians, are quartered in 1,728 camps located throughout the country and employed in improving federal, state and adjoining private lands under supervision of the Forest Service, Soil Erosion Service, National Park Service, Bureau of Reclamation, Bureau of Animal Husbandry, Bureau of Indian Affairs, Biological Survey and other government agencies. The men receive shelter and subsistence plus a base pay of $30 a month, most of which is allotted to their families. Approximately $575,000,000 had been spent to Jan. 1, 1935, from funds supplied by PWA, the drought-relief appropriations and other funds. Under its present authorization the CCC would expire March 31, but the President has announced his intention to extend it beyond that date. Funds for that purpose will be allotted from the proposed $4,000,000,000 work-relief fund. Supervision of the CCC is by the Emergency Conservation Work (ECW), the War Department and the various bureaus noted above.

Surveying and mapping

Surveys to supply basic engineering data have been considerably expanded under the emergency program, and their importance is stressed in the report of the National Resources Board, which recommends a $117,000,000 program to complete the topographic map of the United States in ten years. Additional stream gaging, soil surveys and other basic work also are recommended by the board.

The Coast & Geodetic Survey operations were considerably expanded by emergency allotments. In addition to the regular appropriation of $2,152,000 for the current fiscal year (July, 1934—June, 1935), the PWA allotted $7,390,000, of which $2,839,000 was spent in the past fiscal year, and the rest is to be expended by June 30, 1935. The original Public Works Administration program was laid out for 1,800 men but was stepped up to 2,400 this winter. The PWA work has been about equally divided between: (1) interior control surveys, aimed at covering the entire country with triangulation networks and precise-level lines at 25-mile spacing, and (2) surveys to modernize coastal charts, largely on the inland waterway system along the Atlantic and Gulf coast. An additional $40,000 was allotted by PWA for earthquake studies in California.

THE three main work units of the recovery program, which supply either funds or labor for a major part of the activities of other units, are:

1. PWA — Makes loans to public and semi-public agencies mainly for contract work of the heavy construction type; is the principal source of allotments for work activities of other federal agencies.

2. FERA—Makes grants to states for relief activities, a growing share being used for work relief, mainly of the hand-labor and force-account type but including some work in nearly all classes of construction. Under the CWA, grants were extended also to federal agencies for special work projects, but this method was abandoned in favor of the decentralized set-up with broad powers given to the state administrators.

3. ECW (CCC) — Employs young men in camps mainly on reforestation, erosion control and related activities, but enters some construction activities with close relationship to other federal agencies (Army, Forest Service and Park Service).

In conjunction with the Civil Works Administration program a year ago the PWA allotted $563,000 to the Coast & Geodetic Survey for supervision; 10,200 men were employed in 48 states on secondary leveling and traverses at the height of the program. Instruments were assembled from local sources. After the CWA work was transferred to state ERA (Emergency Relief Administration) supervision, employment fell to 2,000, but it has risen to 2,900 in 23 states. Of the present force, 70 per cent have college training, mostly in engineering.

The Topographic Branch of the Geological Survey had funds totaling $1,735,000 for the fiscal year 1934 and $1,860,000 for 1935, including regular appropriations, PWA, state cooperative funds, etc. The branch's usual budget runs about $1,250,000 per year. Regular topographic surveys were continued in 48 states. CWA work was undertaken in a few states, mostly planimetric mapping, in some cases by air photography.

The Water Resources Branch of the Geological Survey had $1,500,000 from all sources for the current fiscal year, about the same as the year previous. Cooperative stream-gaging work has continued with the states. PWA funds were used in repairs and improvements to gaging stations. Groundwater and quality of water studies were continued. CWA work was relatively minor—mostly statistical.

The Weather Bureau, under a PWA allotment of $150,000, made repairs and relocations of its river gages, established for flood work, and coordinated this activity with the stations

REEDSVILLE, W. VA., subsistence-homestead project, much criticized for lack of coordination in the construction of its houses.

of the Water Resources Branch. Work of the Topographic Branch included mapping on a number of rivers, providing data for streamflow studies.

Forest Service

Protection and development of federal forest properties provide a huge work reservoir that constitutes one of the principal phases of the President's new work-relief program just as it has occupied the front rank of previous emergency work programs. Projected for years ahead, the planned work of the Forest Service afforded a broad foundation for immediate employment when funds were made available by the Public Works Administration, Civil Works Administration, Emergency Conservation Work (Civilian Conservative Corps), and the Federal Emergency Relief Administration. The national forests furnished more than 26,000,000 man-days of work during a twelve-month period in 1933-34, and present plans indicate the need for 20,000,000 man-days of work annually for years to come. In addition, the Forest Service planned and supervised numerous projects on state-owned or managed forest lands, private forest lands and private lands on which erosion-control work was authorized by the Emergency Conservation Work Act. The Forest Service has directed 80 per cent of all work done by the CCC.

In addition to its regular appropriation of $18,800,000, which includes $11,500,000 for forest roads and trails for the current fiscal year, the Forest Service has exhausted allotments by PWA totaling $41,000,000, of which $15,000,000 was expended on construction and maintenance of forest highways, $10,000,000 on forest roads and trails and approximately $16,000,000 on forest improvements, such as tree planting. An allotment of $20,000,000 from CCC funds was applied to the acquisition of forest lands. During the fiscal year ended June 31, 1934, 4,206,000 acres were approved for purchase at a cost of $10,007,000, and in addition title was taken to 574,000 acres costing $1,310,000. The progress made in one year in land acquisition closely approaches the total of the entire preceding 22 years in which the program has been carried on! The United States now owns or is in process of acquiring 12,068,000 acres; but this, according to the Forest Service, is slightly less than one-half the area within established purchase units that should be federally owned.

Girdling the Great Plains

A spectacular feature of the Forest Service program is the forest shelter belt, a zone 100 miles wide bisectin the Great Plains from Canada to th Texas Panhandle. This is a grandios attempt to protect the relatively treeles Middle West from searing winds. A announced by the President, the projec was estimated to cost $75,000,000 over a 10-year period, $15,000,000 being authorized initially; but the Comptroller General ruled that a project of such a permanent character would have to be authorized by Congress. The project, therefore, was initiated this year with $1,000,000, which the Comptroller-General fixed as the limit for experimental work.

No provision is made for the tree belt in the regular budget of $16,952,000 for 1935-36, which the Forest Service submitted to Congress; but $3,500,000 is recommended in its emergency work budget to be covered out of the work-relief appropriation. With the limited supply of nursery stock available, 150 miles of shelter belt can be planted next spring, an average of 25 miles in each state.

The Shelter Belt, so-called, is not projected as one continuously forested area but merely as an area in which thousands of tree belts will be planted. In order to distribute the benefits of tree planting equitably, a standard has been adopted that provides for one mile of shelter belt in every square mile of land. Exact location and final distribution of these belts will have to be decided in accordance with wind direction, topography, improvements, and other conditions as they exist on the ground. Strips of land 10 rods wide and of undetermined length will be acquired by the government ,fenced and planted. In accordance with the standard adopted, these will occupy 20 acres in each section of 640 acres.

Control of soil erosion

Control of soil erosion, long preached by conservationists but never before at-

AT RED HOUSE, Putnam County, W. Va., the FERA has its most pretentious project, 153 houses of cinder block and frame construction. Homesteads on the FERA project run from 20 to 40 acres, with houses grouped in communities.

tempted on a wide scale, has become one of the main pillars of the natural resources program, for the dual purpose of conserving the soil for farm and forest uses and of preventing the silting of streams and reservoirs. An initial allotment of $5,000,000, later increased to $20,000,000, was first given by PWA to the Bureau of Agricultural Engineering and then was withdrawn in order to set up the Soil Erosion Service of the Department of Interior in October, 1933.

The Soil Erosion Service employs a variety of control methods to fit local conditions. Serious gullying is checked by dams and ditches. Land which has become non-tillable may be planted with trees or grasses. Sheet erosion on tillable land may be checked by terracing or by agricultural methods such as contour cultivation, strip cropping, and the planting of cover crops. The program is one both of construction and education.

Some 40 projects have been announced, covering 28,000,000 acres in more than 30 states. As of the end of the year, $12,827,000 had been allotted to projects: $910,000 was tentatively earmarked for proposed projects, and the remaining $6,263,000 was in reserve.

An additional project covering 11,500,000 acres, exclusive of national forests, in the watershed of the Rio Grande in New Mexico, has been given an initial allotment of $200,000. Protection of public investments in the Elephant Butte and Middle Rio Grande Conservancy projects is foreseen. The original estimate of the life of Elephant Butte Reservoir was 233 years, but this has been reduced to 100 years by silting, produced by erosion.

In order to train technical men for its work, the Soil Erosion Service is giving special courses to more than 1,000 young college men who work on projects at PWA wage rates and attend classes on their own time.

A study of reservoir silting by the Erosion Service shows that in the Southeast the smaller reservoirs more than a few decades old have been filled, that larger ones are filling at the rate of 60 acre-ft. per 100 square miles of drainage area per year; and that silting is accelerated in areas not protected by vegetal cover.

MANY MILES OF PARK ROADS have been repaired or built for the National Park Service by CCC men. This road maintenance is in the Grand Canyon National Park

Retirement of submarginal land

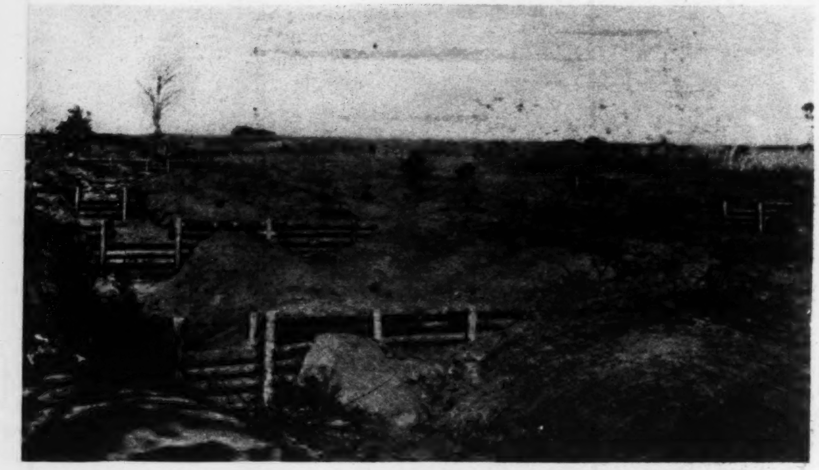
Purchase by the federal government of submarginal farm land and its retirement from cultivation is a widely publicized feature of the Administration's rural rehabilitation program. The location and extent of actual operations have been concealed in order to discourage land speculation, but the total involved to date is only $25,000,000 allotted by Congress in appropriating public-works funds. This fund has been entirely exhausted.

Tennessee Valley Authority

Combining all objectives of the President's program on natural resources with economic and social rehabilitation in one area and under one agency, TVA was organized in the summer of 1933 and is now in action on a broad front. Of $75,000,000 allotted to date, $24,000,000 has been spent for materials and $11,000,000 for wages. Of 13,000 persons now on the payroll, 10,000 are employed on construction, mainly on three dams.

The original plan was to build only the $34,000,000 Norris Dam[2] on the Clinch River near Knoxville for storage and supplemental power, tying it in with the big plant at Muscle Shoals. Local pressure, however, forced the building also of Wheeler Dam, next above Muscle Shoals, to cost $25,000,000. In November, 1934, a third dam was authorized at Pickwick Landing, to cost $22,000,000, and preliminary work has started. Erection of a $2,500,000 transmission line from Norris to the Shoals is well under way. Norris and Wheeler dams are at present scheduled for completion in the latter part of 1936.

Meanwhile TVA is seeking a market for the power it already has at Muscle Shoals and is now supplying adjacent areas in Tennessee, northeast Mississippi and northwest Alabama; 200 miles of rural lines have been built, principally in Tupelo County, Miss. The Electric Home & Farm Authority, a subsidiary, is helping to finance household appliance sales, to build the power load. Forty private manufacturers are cooperating in the manufacture of special types of refrigerators, water heaters, ranges and farm pumps.



SMALL TIMBER DAMS are used by the Soil Erosion Service to check the development of gullies. View taken on Piedmont project, Greenville County, S. C.

Several private utility companies also are cooperating.

Soil-erosion control is being carried on in conjunction with CCC. There are now 30 camps, totaling 6,400 men, located in the valley, and terracing clubs are being formed among farmers who combine locally to buy a tractor for common erosion-control work. Extensive reforestation is under way; 5,000,000 black locusts are to be planted this spring. Efforts are being made to improve tree types, raise nuts, restore the chestnut by importing Asiatic trees, etc.

Tied into the agricultural phase is fertilizer production at Muscle Shoals. Plants have been built for production of phosphoric acid made from rock mined on property leased by TVA.

Topographic maps of the valley area are being made by the Geological Survey. Navigation is spoken of as a coming phase, both to extend the valley economy and to serve as a constitutional basis for other activities, which have been challenged in the courts.

National Park Service

The work of the National Park Service has been extended to include maintenance and construction work on most of the parks and buildings in Washington, formerly under special boards; also certain federal buildings outside of Washington, the military parks, monuments and some military cemeteries formerly under the War Department. PWA allotments include $24,417,000 for roads and trails and $9,235,000 for physical improvements. More than $17,000,000 has been spent, and most of the balance obligated. In addition, there was a $5,000,000 appropriation for roads and trails for the current fiscal year.

Building work in Washington has included remodeling the President's executive offices ($325,000) and air-conditioning the White House ($135,000). The White House work was done under allotments additional to the above. Air-conditioning the Interior Building is costing $1,200,000. Approximately $750,000 has been spent on miscellaneous building work in Washington. The Park Service also handled the paving of Constitution Avenue, one of the new main thoroughfares of the capital, built five bridges in Rock Creek Park and made repairs to the Washington Monument.

Work on national parks and monuments and military parks included the building of new administration buildings, sewer systems, etc. Principal highway work included 70 miles in the Shenandoah National Park and adjacent areas, now completed or under way, and projects in the Great Smoky National Park. Upwards of $6,000,000 was allotted for the Shenandoah Parkway. Extensive CCC work is being carried out in the parks. Under CWA, a survey was made of 500 historic buildings. Jobless architects were retained to make plans and drawings.

Indian Service

The Indian Service has done extensive work in reforestation, in cooperation with CCC, and has built roads, hospitals and other works on reservations throughout the country. Total allocations were $19,264,000 from PWA, $19,875,000 from ECW, and $1,922,000 from CWA. During the fiscal year ended June 30, 1934, $6,600,000 of the PWA money, $9,574,000, of the ECW, and virtually all the CWA money was expended. Estimates for the current fiscal year contemplate an expenditure of $9,196,000 from PWA and $10,293,000 from ECW funds. $2,500,000 of the PWA money is reserved for use at the discretion of the President. Employment through the 1935 fiscal year is estimated at 4,365 men on PWA projects and 11,000 on ECW. It is almost entirely force account, Indian labor being used under white supervision.

Housing

Housing might almost be defined as an obsession of the New Dealers which, so far as construction is concerned, has largely spent itself in dispersion of effort. In low-cost housing the PWA floundered around for months before discarding the limited-dividend corporation as the means to that end and engaging directly in construction. Participation of private capital was made practically impossible by the terms laid down by PWA, coupling low-cost housing with slum clearance in almost every instance and then trying to reconcile the cost to rentals within the reach of the incomes of slum dwellers. Recently the Federal Housing Administration has set up more liberal procedure for utilizing private capital, and the first project (at Meadville, Pa.) has been approved.

Homestead settlement of needy from industrial areas under the Subsistence Homesteads Division of the Department of the Interior, and similar aid to the rural needy under FERA, have reached the construction stage on a number of projects.

The division has approved 62 projects, including 6,600 homesteads, and has announced 43 of these, to include 5,000 homesteads. Construction has started or contracts will soon be let for 23 projects embracing 1,100 homesteads. No projects are completed. Approximately 170 houses are finished; 300 more are scheduled for completion about March 1; and an additional 300 are under construction. Some 50,000 acres of land have been purchased, at a total outlay of about $1,150,000. The average homestead runs about 15 acres. Those in rural districts are larger, while those near cities run as low as one acre per house.

The original policy was coupled with decentralization of industry, but, as this proved to be impracticable, most projects have been located close to industrial centers, from which the homestead settlers are drawn. The division has only two distinctly rural projects, as it soon became apparent that it was futile to expect industry to come where the projects are located.

The average cost per homestead is claimed to be about $3,000, including house, outbuildings, land, public utilities and often feed, fertilizer, seeds and animals for the first year's operation. Settlers pay for the homesteads over 30 years at 3 per cent. Monthly payments average $4.22 per $1,000. Only 100 are settled in houses thus far, and 100 more are living on homesteads while working on houses. Some projects are handled by contract labor, others by force account.

Considerable criticism has been leveled at the project in Reedsville, W. Va. In this development prefabricated

ASPHALTED SAND BAGS being assembled to form a spillway for erosion control in Graham County, Ariz.

houses were brought in; cellars were added as an afterthought, and remodeling was done at a high unit cost.

Under the Rural Rehabilitation and Stranded Populations Division of FERA, three closely similar projects are being built by force-account labor from relief rolls, mostly prospective settlers, under the immediate charge of state directors of relief. Numerous projects still are in preliminary stages.

Homestead projects of the FERA are set up on a self-liquidating basis. Of the three projects, 100 homesteads are completed and occupied at Woodlake, Tex. In Mississippi County, Ark., 139 out of 700 houses are finished. The houses are of wood, mostly produced by portable sawmills from timber cut on the colony land. Mass production methods are used for cutting the framing and trim, but the architectural style is varied. The third project is at Red House, W. Va., with 153 houses finished. Buildings are of cinder block.

Costs per house run from $1,000 on the southern jobs to $2,300 at Red House. Homesteads run 20 to 40 acres, the houses being grouped in a community center rather than scattered as in the Subsistence Homesteads Division projects. Efforts made to attract industries to the FERA projects are meeting with success, according to Harry Hopkins, FERA administrator.

TVA has completed its "model town" at Norris, Tenn., with 351 houses occupied by employees. Costs per house run from $1,200 to $6,000, and rentals range from $19 to $40 per month. None of the houses is for sale. The adjacent construction camp for Norris Dam ultimately will be an industrial center, according to present plans. Ceramic industries are planned, with kilns heated by electricity. Demonstration farms, farm cooperatives, parks and forest reserves tie into the Norris development. TVA has no subsistence projects, but community garden plots are provided at Norris.

Modernization and construction

The National Housing Act, approved June 27, 1934, is significant, apart from the particular functions assigned to the Federal Housing Administration, as representing an attempt by the administration to bring private capital to the support of a New Deal enterprise. FHA's activities embrace a short-term program of modernization and repair and a long-term program of home financing. Modernization loans made to date by 4,158 banks and other institutions number 84,757 for a total of $35,650,000, as of Jan. 24, 1935. FHA's contract with the lending institutions indemnifies them for all losses up to 20 per cent of the total amount of loans made on the terms specified by FHA.

Revival of residential construction is the ultimate objective of FHA's mutual mortgage insurance system, under which loans up to 80 per cent of appraised value, which may not exceed $20,000 of old or new property, are insured if terms, plans and specifications conform to FHA standards. The basic rate of interest is 5 per cent, and the period of amortization may extend to twenty years.

FHA's first objective is to rehabilitate a large portion of the $21,000,000,000 of existing home mortgage debt. As and when this is accomplished, FHA's standardized procedure for home-mortgage lending is expected to stimulate the latent demand for new houses.

Refinancing distress mortgages

The Federal Home Loan Bank Board was created July 22, 1932, to establish a permanent system of twelve home loan banks with a present share capital of $125,000,000 advanced by the government and $22,000,000 subscribed by 3,127 building and loan associations, insurance companies and savings banks. To such member home-financing institutions the FHLBB has authorized 5,614 loans totaling $145,000,000. Cash actually advanced totals $135,000,000, and repayments $51,000,000. FHLBB has contributed $16,000,000 on a $3 for $1 basis in establishing 671 federal savings and loan associations, with aggregate resources of $145,000,000. Under Title IV of the National Housing Act, FHLBB also supervises the insuring of share accounts in home-financing institutions up to $5,000 for any individual account. As of Jan. 14, 471 institutions with resources of $120,000,000 had been insured.

Because provisions of the Federal Home Loan Bank Act providing for direct loans to distressed home owners proved unworkable, the Home Owners Loan Corp. was organized June 16, 1933. With a share capital of $200,000,000 subscribed by the U. S. Treasury, HOLC is authorized to issue $3,000,000,000 of bonds. Of this amount, $2,400,000,000 has been exchanged for mortgages on 750,000 homes. The $3,000,000,000 bond limit will be raised by Congress to $4,000,000,000 or more to cover 350,000 to 400,000 of pending applications in excess of the HOLC's present resources and probably to take care of new business, which was suspended Nov. 13, 1934. The original issue of HOLC bonds totaled $633,000,000; interest (4 per cent) but not principal was guaranteed by the government. Later, $1,096,000,000 of 3 per cent bonds and $1,271,000,000 of 2¾ per cent bonds was issued, both fully guaranteed as to principal and interest. HOLC has loaned $45,000,000 for home repair and reconditioning and $144,720,000 for payment of delinquent taxes on refinanced property.

Miscellaneous

Allotments from the PWA have stimulated a wide range of engineering activities among agencies of the government which are not here reported in detail because they are not new phases of the conservation, land-use and housing program that has been discussed. The wide influence of PWA along engineering lines is shown by the fact that PWA itself employs some 2,000 engineers, while other federal agencies are employing 5,000 engineers under PWA funds.

Normal public activities that have been notably expanded by PWA allotments include highway work under the Bureau of Public Roads; reclamation projects, with power, water supply and other features appended under the Bureau of Reclamation; river and harbor work of the Corps of Engineers; public buildings under the Procurement Division of the Treasury; and a large shipbuilding program under the Navy Department.

Geodetic Control Net Aided by PWA-Financed Work

Work during seven months of 1934 added 63,000 miles of leveling and 13,700 miles of triangulation arcs to the country's control system

By W. Bowie
Chief, Division of Geodesy, U. S. Coast and Geodetic Survey

During the last seven months of 1934 survey work under the direction of the U. S. Coast and Geodetic Survey, made possible by PWA financing, added about 63,000 miles of leveling and 13,700 miles of arcs of triangulation to the existing national control net. These additions to the country's control system, being extended by the U. S. C. & G. S., are particularly significant because these figures represent increases of 54 per cent and 28 per cent, respectively, over the amount of work that had been done previous to May 1, 1934. The funds made available for this work by the PWA resulted from a study of Administrator Ickes and the subsequent conclusion that the work to be done would be of lasting benefit to the nation.

The Coast and Geodetic Survey has for many years been following a plan of making networks of lines of levels and arcs of triangulation over the country with the spacing of the lines and arcs at intervals of about 25 miles. These are the fundamental nets. They correspond to the principal beams and columns in the steel framework of an office building. Much more work will be needed to furnish all the additional data to be used as control for topographic mapping and as starting points for surveys connected with engineering projects and cadastral work, but it is considered essential that the principal framework should be rushed through to rapid conclusion.

Accuracy of work

In the nets, work of the first order in accuracy is spaced at intervals of 100 miles. Intermediate areas are covered with the lines of levels and arcs of triangulation of the second order. The second-order work is not weak in accuracy, as its designation might indicate. A line of second-order levels is a line run in only one direction but with the same instruments and by the same methods as are employed in the first-order leveling where the line is run in both directions.

For the triangulation also, the second-order work is done with the same instruments and by the same general methods as are used in the first-order triangulation. The only difference is that on a second-order arc the closing errors of the triangles may be slightly larger. Single triangles are satisfactory on second-order work, while on first-order triangulation it is only occasionally that a single triangle is used. In general, on first-order work the figures of the arc are quadrilaterals with both diagonal lines observed or they are central point figures.

On second-order triangulation the number of observations may be somewhat less than on the first-order work. With modern instruments, such as are used by the Coast and Geodetic Survey, the observations of the main scheme lines at a first-order station can be completed within 1½ hours. Since the greater part of the work on triangulation is selecting the stations, marking them, building the towers to elevate the instruments in order to clear lines, and the traveling to and from the stations, it is readily seen that there would be little economy in reducing the number of observations even to half of those used on first-order work. The time saved would be exceedingly short.

Allowable errors

On first-order triangulation the maximum allowable closing error of a triangle is 3 sec. The average closure of triangles is very close to 1 sec. On second-order work the allowable maximum closing error of a triangle is 6 sec., and the average is somewhat less than 3 sec. As a matter of fact, on second-order work the maximum closing error seldom reaches 4 sec.

On first-order leveling the backward and forward running of the lines must give results that agree within 4 mm. times the square root of the distance in kilometers or 0.017 ft. times the square root of the distance in miles. On second-order leveling there is, of course, no double running of the line and, therefore, the only criterion that can be applied for accuracy is the closing error of the line when it is joined to the first-order net. Here the accuracy required is designated as 8.4 mm. times the square root of the distance in kilometers as the maximum correction that may be used in fitting the second-order run into the leveling net. If the rate per kilometer of this closing error is greater than that specified, a second running of the line is made.

It has been very fortunate that funds were made available under the Wagner Bill in 1933 and by allotments of funds from the Public Works Administration in the late summer and early fall of 1933 for continuing and accelerating the work on control surveys.

There is strong sentiment throughout the country and in government agencies favoring the completion of the program of topographic mapping. President Roosevelt has, on several occasions expressed his interest in the mapping of the country. Taking everything into consideration, it is quite likely that the administration will make funds available in substantial amounts for initiating a more rapid prosecution of topographic mapping. Only half of the country has been covered by topographic maps, and half of those maps are so out of date or sketchy as to be unsuitable.

Topographic maps to fill in

With the control surveys so well advanced, it will be possible to make topographic maps in any area of the country and have the topographic features shown in their true geographic position and the contours at their correct elevations. Within the next few months it is probable that all of the 25-mile spacing of the lines of levels of the leveling net will be completed, and it would only require three or four years more at the present rate of progress to complete the 25-mile spacing of the triangulation net.

For any topographic mapping, whether by air photography or plane-table surveys, a fairly close spacing of the horizontal and vertical control survey stations is essential. It is generally assumed that if triangulation stations or lines of traverse are spaced at intervals of 5 to 7 miles this will be adequate control for the completion of a planimetric map from air pictures or for the use of engineers operating with plane tables. Likewise, the lines of levels over the area to be contoured should be spaced at about the same intervals. Since the fundamental leveling net will be completed shortly and the triangulation net can be completed quickly for any given area, the detailed control for the mapping can be done in a few months for any local area in which the topographic mapping is to be started.

Not only are the results of the control surveys of value in the topographic mapping of the country, but they are of value in many classes of engineering. There are few engineering operations that do not depend upon elevations. These elevations are now available for the greater part of the country. Within the area for which the leveling net is completed there are very few points that are more than 12 to 15 miles from one of the standard benchmarks.

Accuracy maintained

It is noteworthy that in spite of the great expansion in geodetic surveys during the past two years there has been no decrease in the efficiency or in the accuracy of this work. The normal high standards of the geodetic surveys of the bureau have been maintained. Nearly all of the observing on geodetic parties is done by engineers who have had no previous experience in geodetic work. They were employed and given extensive training in the use of the theodolite and the precise level, and after having become skilled in their use they have been placed in charge of sub-parties working under the direction of the chief of party, who, with few exceptions, has been one of the permanent staff of engineers of the bureau.

Work under FERA

Late in 1933 the Civil Works Control Survey Project was authorized by the Federal Relief Administration, to be administered by the U. S. Coast and Geodetic Survey. It authorized the employment of 15,000 persons and by the middle of February, 1934, had employed 10,300; more than half were engineers. At that time the project ceased to be a federal one. It was, however, continued under state relief administrators in 44 states for various periods. Twenty-one states still have this work under way. The present personnel is approximately 2,500 persons, half of whom are engineers.

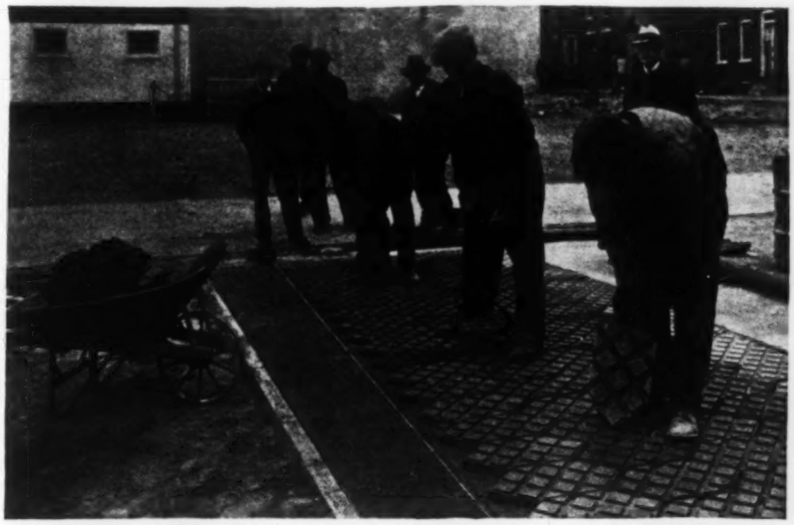
The work necessarily could not be done with what may be considered normal efficiency. There were various serious and unusual difficulties involved in initiating and prosecuting such a large project, chief of which involved instrumental equipment. There was not time for purchasing the high-grade transits and levels that should be used on such control surveying, but in spite of this the work was well done and in practically all cases was up to the high standard set in the specifications prepared by the Coast and Geodetic Survey. Instruments were secured from many sources: state highway departments, engineering departments of cities, universities and technical schools, railroads and other corporations and from private individuals. The response by the owners of instruments to put engineers to work was most commendable.

Work under way

There are now 51 triangulation parties and 76 leveling parties in the field. On these parties more than 300 engineers are employed and paid with PWA funds. Each one of these men will be able, when he leaves the Coast and Geodetic Survey, to do excellent geodetic surveying for any state, county, city or private corporation. His experience is practically that of a post-graduate student at a university or technical school. In addition to the field work, there are 145 engineers employed by PWA money in computing and adjusting field observations, in preparing data for publication and in sending out information to the field parties and to others who may request it.

Cast-Iron Block Pavement at Wilmington, Del.

New type cast-iron block of American design being tested on short section of street carrying heavy truck traffic



LAYING CAST-IRON PAVEMENT at Wilmington, Del., for heavy truck traffic service test.

CONTINUING interest in cast-iron roadway surfacing is indicated by the installation of a 30-ft. test section in Wilmington, Del., by the state highway department, the city street and sewer department, and the Lobdell Car Wheel Co. The test is being made to verify the many claims of European engineers for the advantages of this type of roadway surfacing. The first test section of cast-iron roadway surfacing laid in the United States is believed to be that installed on the campus of the University of Minnesota (*ENR*, Nov. 8, 1934, p. 599).

The test section just installed in Wilmington was laid in connection with the widening and resurfacing of two city streets to serve as a bypass for heavy truck traffic to relieve the congestion on the streets in the central part of the city. The pavement is 28 ft. wide between concrete gutters and is 30 ft. long. The plates used in this test are a departure from the conventional European designs and were designed by the Lobdell Car Wheel Co. in collaboration with W. W. Mack, chief engineer, and E. Earle Downing, resident engineer for New Castle County, of the state highway department, and Harry L. Maier, chief engineer of the street and sewer department.

Desiring to eliminate the straight-line joints that are characteristic of the European designs and to reduce vibration of traffic, the plates were made in the form of an irregular hexagon, and the surface bosses or studs were increased in area and so placed that their surfaces overlapped. The illustration shows these features as well as the method of laying the plates. Special header, corner and side plates were made of considerably greater area than the plates used in the main area of the pavement, to afford security to the edges and to prevent the tendency of starting any loosening or failure due to inequalities between the cast-iron and adjoining pavement. The smaller hexagonal plates making up the main body of the pavement are about 10 in. wide and 20 in. long from apex to apex. They have small ¼-in. studs on the edges so placed as to insure an opening between the plates of at least ¼ in. They are 9/16 in. thick with 2-in.-square raised bosses 5/16 in. high arranged at 45 deg. with the center line and separated by about 1 in. The under surface is reinforced by ribs, which makes the effective depth of the plates from the top surface of the bosses to the bottom of the ribs 1½ in. The weight of these plates is about 32 lb. each. The weight of the finished pavement (the cast iron only) is about 265 lb. per square yard. Since the rather limited quantity required for this installation did not warrant the investment in special molding equipment, very little actual data could be obtained on the ultimate cost of production. The plates were actually produced at a cost of about $5.50 per square yard of effective area.

Owing to the fact that the test installation had to be laid to match with a 2-in. bitulithic concrete surfacing used on the remainder of the street, it was necessary to lay it upon a cushion approximately 1¼ in. thick. A loose cement and sand cushion was used (3 parts sand, 1 part cement slightly dampened).

The joints between the plates were filled with hot asphalt. The laying developed no serious difficulties. Aside from the special tongs shown in the illustration, which were used merely for convenience, no special equipment was required. The work was done by the regular city paving crew.

Dowels and Joint Fillers for Concrete Pavements

Effect of dowel spacing on slab stresses at joints—Dowel installation—Appraisal of joint fillers—Cost of adequate pavement jointing

By R. E. Toms
Chief Division of Design, Bureau of Public Roads, Washington, D. C.

DOWELS continue to be the most common means employed by the highway engineer to transfer vehicle loads across joints in concrete pavement slabs. Even the more recent inventions in air-cushion and metal water-seal joints in most instances utilize dowel bars. Dowel spacing, shape, installation and cost therefore are a vital part of the concrete roadbuilder's problem. In this article, greatly condensed from a paper prepared for the Association of Highway Officials of the North Atlantic States, the chief of design of the federal highway authority presents data and opinion on doweled joints that call for earnest consideration. EDITOR.

PROVISION for load transfer across transverse expansion and contraction joints is necessary to secure a slab structure of balanced design. Westergaard's analysis of the stresses in concrete pavements is predicated on the assumption that load pressures on the interior of an unbroken slab are distributed uniformly over the area of a small circle, while load pressures at the edge of the pavement are distributed uniformly over the area of a small semi-circle. For any given load and any given thickness of slab and assumed modulus of subgrade reaction, the stresses produced at the edge of a slab may be as much as 50 per cent greater than the stress produced by the same load on the interior of an unbroken slab.

The application of load to a transverse joint without load transfer causes stresses of the same intensity as the application of load to the edge of a slab. For balanced design, therefore, it is essential that provision be made for load transfer across joints. Westergaard has presented an analysis of the mechanics involved in the action of dowels used for this purpose. The analysis treats the case of uniformly spaced dowels with a load applied entirely on one side of the joint and midway between two dowels. The specification is set up so that the two slabs shall have the same deflections at the points where the dowels bridge the joint opening. For this condition formulas are developed which express, in terms of the applied load, the dowel reactions for the four dowels nearest the point of load application.

Dowel spacing and slab stress

The following brief discussion relative to the spacing of dowels has been prepared by Mr. Teller, of the division of tests, Bureau of Public Roads:

By means of the more exact formulas given by Westergaard, i.e., those in which the reactions of all four dowels are considered, the amount of stress reduction which results from dowel spacings varying from 12 to 36 in. has been calculated for two degrees of subgrade stiffness and for the five different thicknesses of slab, using reasonable values for the modulus of elasticity of the concrete and for Poisson's ration. The results of these rather extensive computations are presented graphically in the accompanying illustration.

The charts at the left show the effect of dowel spacing on the reduction in slab stress computed for loads such as would cause a stress of 300 lb. per sq.in. at the free edge of each of the several slab thicknesses on each subgrade. Thus, a very moderate stress condition is represented by the values shown. The way in which the relation between dowel spacing and stress reduction changes as the slab stress increases is indicated by the groups of curves at the right, which show the same relation computed for a wheel load of 10,000 lb. for all cases regardless of slab thickness and subgrade stiffness.

Both of these figures show very clearly that both the amount and rate of stress reduction increase as the dowel spacing decreases. It is indicated that even for the ideal condition represented by the basic specification, dowels spaced 3 ft. or more apart are of little or no value in reducing the slab stresses. When the dowel spacings are 2 ft. or less, the dowel reactions become more effective in reducing stress, and the analysis indicates that dowels should be placed quite close together if they are to be of appreciable value in reducing edge stresses.

Both theory and experiment show that a load which will produce a stress of 300 lb. per sq.in in the free edge of a pavement slab will cause a maximum stress of slightly less than 200 lb. per sq.in. when applied at the interior of a slab of constant thickness. Thus, in this type of slab complete continuity will effect a stress reduction of only a little more than 100 lb. per sq.in. The left-hand curves indicate that to accomplish

EFFECT OF DOWEL SPACING on reduction of edge stress computed by Westergaard's exact method. Left, load such as to produce edge stress of 300 lb. per sq.in. Right, load 10,000 lb. on all slabs. In both cases $E = 3{,}000{,}000$ lb.; $\tau = 0.15$ and $a = 4$ in.

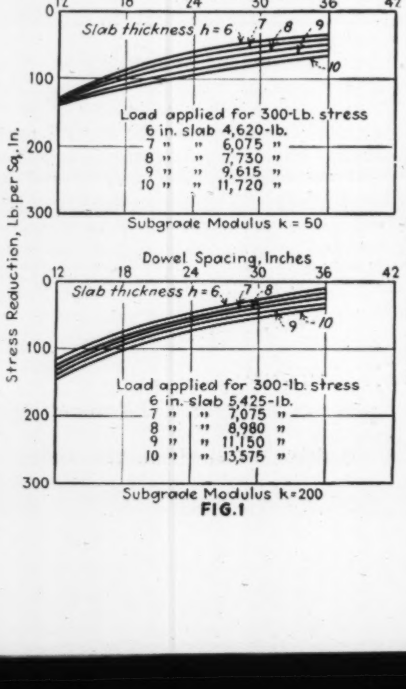


FIG.1

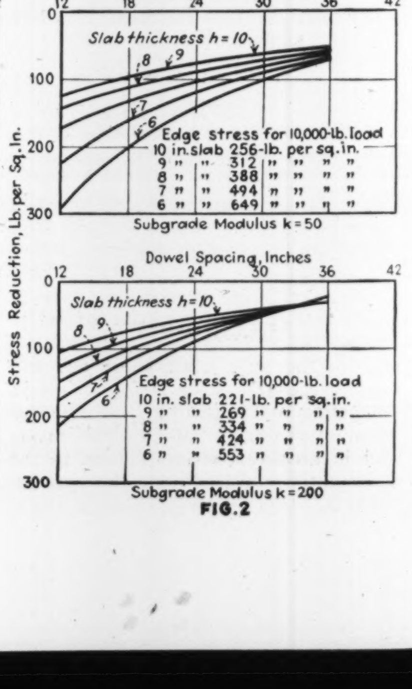


FIG.2

this same reduction with dowels, a spacing of approximately 18 in. would be necessary on a 10-in. slab and approximately 15 in. on a 6-in. slab.

This analysis assumes perfect dowel action. The dowels themselves are assumed to be so stiff that, for the reaction developed, no deflection of the dowel occurs. Further, it is assumed that the dowels seat perfectly in the slab, and complete shear resistance is developed. While it is our belief that the theory is sound and gives an excellent picture of the relation between dowel spacing and stress reduction, it is also believed that the theoretical stress reductions are considerably greater than are to be expected from dowel installations as they are found today.

In the tests now being made at Arlington the transverse joints containing dowels were constructed with joint openings of ½ and ¾ in., dowel spacings of 18, 27 and 36 in., and dowel diameter of ¾ in. in all cases; pains were taken to see that the dowels were installed properly. The tests indicate that the joints of this type with dowels 18 in. or more apart are not very effective in reducing the critical stress caused by a load placed near the joint, the efficiency of the joint construction being generally below 50 per cent. The deflection curves of the slab ends adjacent to the joint show that corresponding points on the two abutting edges do not deflect the same amount. This is probably due primarily to dowel deflection, and perhaps in part to some slight looseness of the dowel in its socket. Whatever the cause, the actual dowel behavior of these carefully installed ¾-in. dowels falls considerably short of the ideal action upon which the Westergaard analysis is predicated. To secure appreciable stress reduction in doweled joints, as actually constructed, it seems to be quite definitely indicated that a dowel spacing of the general order of 12 in. is necessary.

Many of the objections against the use of dowels would be overcome if the shape of the dowels were changed to secure greater stiffness without sacrificing bearing value. This may be accomplished by installing bearing plates in the concrete in which the clearance between the dowel and its bearing is reduced to an absolute minimum, so that the dowel is brought into play without excessive deflection of the slab ends. This may be the ultimate solution, as the amount of steel may conceivably be less than is now used for round dowels, and much greater ease of installation and efficiency would be secured.

Accurate dowel installation

The principal objection to the use of dowels for load transfer is the time and difficulty of securing proper installation. Where the mixer is located on the subgrade, this is of prime importance, as the time lost in installing joint devices necessarily cuts down production. Where the mixer is not located on the subgrade this consideration is not so important, as joint devices may be placed well in advance of the concrete.

Where dowels are used it is absolutely essential that they be accurately spaced parallel to the axis of the pavement, that they be painted and well oiled with a good grade of heavy oil to break bond. Dowels across expansion joints must be provided with metal caps to give sufficient air space for their movement in the slab. If the dowels are out of position, the movement of the slabs creates a funneling action in the concrete which destroys their effectiveness. Dowel bars for load transfer are subject to shearing and bending stresses. It is essential, therefore, that they have continuous close contact with the concrete. Any clearance between the dowel and the concrete permits a corresponding deflection of the pavement slab before the dowel bars become effective. Dowel-bar sleeves or sockets covering one-half the length of the dowel bars should not be used

With the dowel-bar spacing of 12 in. for load transfer, it is an almost hopeless task to secure proper installation of dowels by using individual dowel-bar supports, or pins on each dowel. Unsatisfactory results with dowel bars have been largely due to the abuse of their use. If they are not properly installed, they had better be omitted. Our specifications must provide for continuous dowel support in such a way that the joint, whether contraction or expansion, regardless of type of expansion device employed, be assembled alongside the work and lifted into place and supported in position as a unit.

Cost of various joints

The cost of installing transverse expansion joints with adequate provision for load transfer will vary according to the type of joint used. The cheapest type is a poured or preformed asphalt filler with dowel bars. On the basis of a 20-ft. width the joint filler of this type may be expected to cost about $2.50 per joint and dowels about $5 per joint, making a total of approximately $7.50 per joint, or $450 per mile for a 90-ft. spacing. If preformed rubber or cork is used for the joint filler, the cost of the filler will be about doubled, while the cost of the dowels will remain the same, making the cost for a 90-ft. spacing approximately $600 per mile. All metallic air-chamber joints with copper seal will range in cost from 45c. to 65c. per foot, exclusive of the dowels for load transfer. Where other means than dowels are used for load transfer with these types of joints, prices range somewhere between these figures.

The cheapest installation for contraction or crack control is the dummy joint or plane of weakness. The cost of forming the weakened plane is almost negligible, the principal item of cost being the dowels for load transfer. A complete installation for expansion and crack control consisting of expansion joints at 90-ft. intervals, with contraction joints or planes of weakness spaced so that the distance between contraction joints or expansion joints is 30 feet, with resilient joint fillers and load transfer across all joints, will cost about $1,100 per mile. This cost may be as much as $2,000 per mile when all-metallic copper-sealed air chamber expansion joints and copper-sealed metallic contraction joints are used.

One principal objection to the use of resilient joint fillers is a belief that the resilient properties will be lost in a few years. No definite answer can be made to this. It may be that joint installations of this type will be developed in which the resilient filler will occupy only the joint space above the dowels so that the joint opening may be cleaned and the filler renewed when it has lost its resilient properties. The sub-grade seal type of joint used in Minnesota has this interesting possibility. Cotton-seed hulls and sawdust packed in joint openings and impregnated with asphalt have been used for some time, but the extent to which they will be effective over long periods is not known.

Experience has rather definitely indicated that metal seals for expansion joints must be of malleable material. Copper is undoubtedly the best material; unless punctured or destroyed by direct application of load, it should be effective for long periods. Hard metal seals have a tendency to split rather easily when subjected to the maximum movement possible in joint construction. Some difference of opinion exists concerning whether premolded bituminous caps or poured bituminous material should be used for the protection of copper seals. Both have been used to a considerable extent. Probably a sticky bituminous material will give better service in the long run.

At the present time we are passing through a transition period of joint development. Definite conclusions regarding the life expectancy or proper functioning of the different devices now being used cannot yet be drawn. As more information is developed from research supplemented by the behavior of these devices under service conditions, it is natural to expect that joint design and installation will become standardized to the same degree as exists with respect to other features of concrete-pavement design such as the design of the concrete mix and the cross-section.

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Canadian Water-Power Figures

The annual review of Canada's water-power resources has just been issued by the Dominion Water Power and Hydrometric Bureau of the Dominion Government. It reveals that the total installed horsepower on Dec. 31, 1934, amounted to 7,547,035 hp., an increase of 214,965 hp. during the past twelve months. The installation of four water wheels at the Rapide Blanc plant of the Shawinigan Water and Power Co. Ltd., was responsible for 160,000 hp.

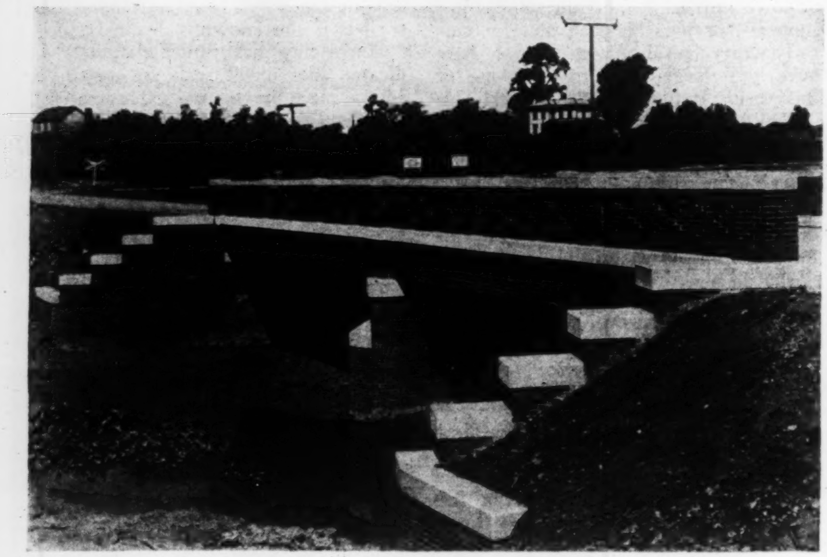
Reinforced Brick Masonry Used in Ohio Bridge

Substructure, railing and sidewalks utilize reinforced brickwork, while deck is of concrete T-beam construction

By J. R. Burkey
Chief Engineer of Bridges,
Ohio Department of Highways,
Columbus, Ohio

A HIGHWAY BRIDGE of unusual type in that it made rather extensive use of reinforced brick masonry has recently been opened to traffic by the department of highways of Ohio. The structure is located on state route 39 at the east corporation line of the village of Sugar Creek, Tuscarawas County, and spans a small stream known as the South Fork of Sugar Creek. This small village is in the midst of the clay-manufacturing industry of eastern Ohio, and since two brick plants with many idle employees were located within a few hundred yards of the bridge site it was decided to design a structure that would make maximum use of the local labor. Accordingly, since the available foundation soil was unsuitable for brick-arch construction, a twin-span concrete T-beam superstructure, on a reinforced brick masonry substructure and with brick facing and railing, was chosen after preliminary estimates indicated this type to be economically justified.

The two spans, skewed 22 deg., are each 32 ft. clear, and accommodate a 24-ft. roadway and two 3-ft. refuge walks. The height from bottom of footings to top of curb varies somewhat for the different substructure units, but is approximately 20 ft., the footings in all cases consisting of concrete resting on timber piles. Above the footings all pier and abutment walls are made of reinforced brick masonry capped with concrete, to protect the vertical joints of the brickwork against entrance of water and to produce a more finished appearance.



REINFORCED BRICK MASONRY comprises the pier and abutments as well as the railing and sidewalks of this concrete girder bridge in Ohio.

In line with the general policy of the bureau of bridges, the abutments are designed with breast wall and wings in a straight line, to facilitate the future widening of the bridge.

Details for the structure were prepared for the use of the standard-size building brick, 2¼x3¾x8 in. with permission to use any size of building or paving brick, if details showing variations in dimensions and patterns were presented by the contractor and approved by the bureau of bridges. Face brick was required to be smooth, dark red and hard-burned, meeting A. S. T. M. specification No. C-62-30 for hard or medium grade building brick. Backing brick was required to meet specification C-32-24 for Class A or B vitrified, or hard or medium-grade clay sewer brick. Face brick was also required to meet the absorption test for hard-grade sewer brick. The brick used was standard-size, dark red, building brick. Common bond was used, with every sixth course as headers, and joints were ½ in. thick. All joints were completely filled with mortar, and all exposed joints were struck, including those on the back of the abutment walls.

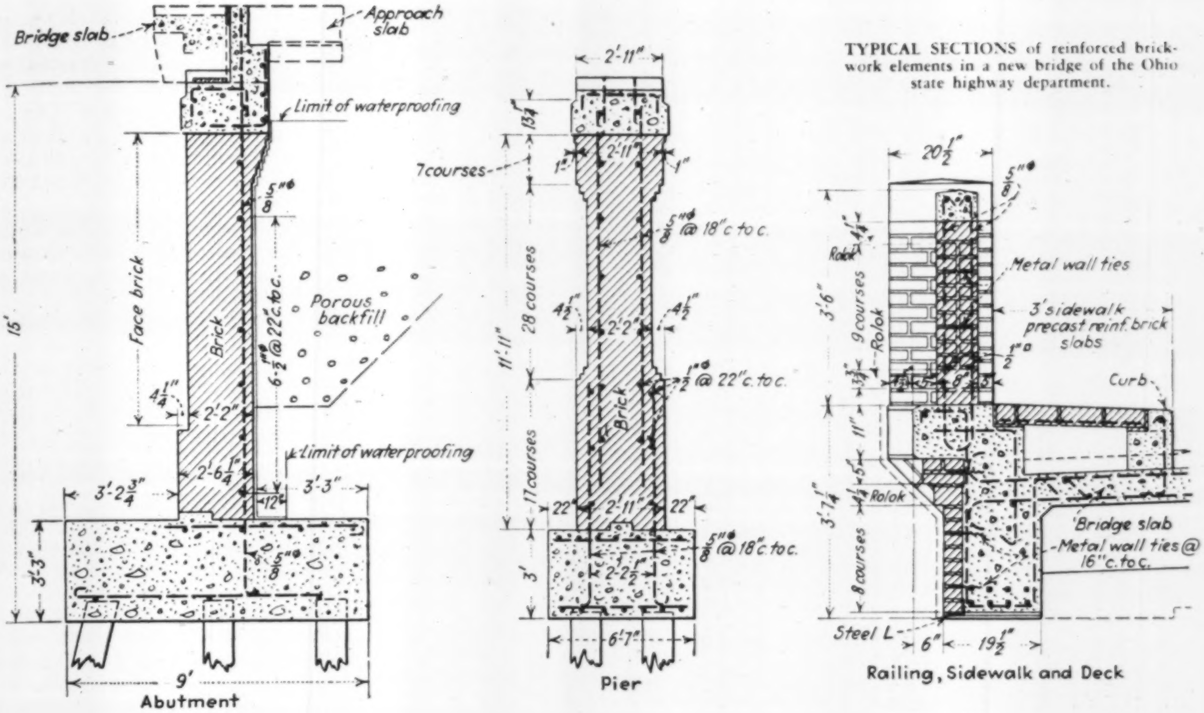
For experimental purposes, so as to determine relative efflorescence, workability, durability, etc., two types of mortars were used. The east abutment was built with 1:3 portland cement mortar to which was added hydrated lime, not to exceed 15 per cent by volume of the cement. The remainder of the brick masonry was built with 1:2½ mortar, using a commercial mortar cement. The latter mortar proved to be much more workable and easy to handle. Its crushing strength, although lower than the portland cement mortar, was sufficiently high to provide a reasonable factor of safety over the design stresses.

Waterproofing, consisting of two coats of hot asphalt, was applied to the back of all abutment brickwork below the ground line; total of 1 gal. per sq.yd. of surface was used. This, together with the concrete capping on all brickwork, was expected to reduce efflorescence to a minimum.

The sidewalks were built as reinforced brick slabs, spanning from curb to coping. Each slab was 3¾ in. (one brick) thick and reinforced with a ⅜ in. round rod in each joint (2¾ in. centers). This slab was precast or laid up as a 4 in. wall in sections about 2 ft. long, allowed to season, and then placed on a mortar bed at both ends. The sidewalks are so designed that they may be removed to facilitate widening of the roadway if required.

An H-15 design loading was used with the following unit working stress in the reinforced brick masonry walls, railing and sidewalk slab: compressive stress in brick masonry, 600 lb. per sq.in.; shear in brick masonry, 20 lb. per sq.in.; bond for deformed bars, 50 lb. per sq.in.; tensile stress in reinforcing steel, 14,000 lb. per sq.in.; and a ratio of modulus of elasticity of steel to brick masonry of 15.

The superstructure was not continuous, but both spans were anchored to the pier, with the abutment ends of each beam resting on two ½-in. rolled phosphor-bronze plates, separated by one layer of 1/16-in. sheet asbestos packing and flake graphite. An open joint 1½ in. wide was left between the sides of the superstructure and the abutment, and a waterproof expansion joint of folded copper and premolded expansion joint filler was provided at the ends of the roadway slab. To prevent lateral displacement of the superstructures incident to skewed construction, blocks of concrete cast monolithically with the bridge seats were placed between the central and adjacent beams. Brick facing on the outside beams was placed


Bridge slab
Approach slab
Limit of waterproofing
Face brick
Brick
15'
5/8"ø
6-1/2"ø @ 22"c. to c.
Porous backfill
4 1/4"
2'-2"
2'-6 1/4"
Limit of waterproofing
3'-2 3/4"
3'-3"
12"
3'-3"
5/8"ø
9'
Abutment
2'-11"
13 1/4"
7 courses
2'-11"
1"
1"
5/8"ø @ 18" c to c.
28 courses
11'-11"
4 1/2"
2'-2"
4 1/2"
1/2"ø @ 22"c. to c.
Brick
17 courses
22"
2'-11"
22"
5/8"ø @ 18"c. to c.
3'
2'-2 1/2"
6'-7"
Pier
20 1/2"
5/8"ø
Rolok
4 1/2"
3'-6"
9 courses
Rolok
Metal wall ties
3' sidewalk precast reinf. brick slabs
1/2"ø
Curb
11"
5"
Rolok
3'-7 1/4"
8 courses
Bridge slab
Metal wall ties @ 16"c. to c.
Steel L
6"
19 1/2"
Railing, Sidewalk and Deck

TYPICAL SECTIONS of reinforced brickwork elements in a new bridge of the Ohio state highway department.

after the concrete was poured. It rested on a shelf angle that had projecting anchors embedded in the concrete. Metal wall ties were also used between concrete and brickwork. The brick railing posts and panels were anchored separately to the concrete coping, leaving ½-in. open joints on each side of posts.

Brick portions of the structure were built in a shorter time than if concrete had been used. The cost of the reinforced brick masonry in the substructure was $13.65 per cu.yd., which compares quite favorably with the usual cost of pier and abutment masonry, while the bid price of $4 per linear-foot for the railing is in line with bids received for other durable railings in which architectural treatment is given prominence. The contract price for the structure was $16,150, not including piling.

Although this design was developed somewhat in the spirit of research, with the added inducement of maximum local employment, the finished structure has received such favorable comment generally that this type of construction can be readily justified wherever conditions and availability of materials are as favorable as they were in this instance.

The bridge was built by the O'Connor-Kipf Co., Cleveland. The work was done under the direction of O. W. Merrell, as director of highways; H. P. Chapman, assistant director; J. R. Burkey, chief engineer of bridges; and Elmer Hilty, chief engineer of construction. J. C. Merrell, of the bureau of bridges, developed the details of the design.

Underground Rock-Dust Control Discussed at Mining Meeting

CONTROL of rock dust in underground workings for the prevention of silicosis was thoroughly discussed at a session of the annual meeting of the American Institute of Mining Engineers at New York, Feb. 18. The meeting is reported here because of the growing importance of the rock-dust hazard in construction. Dan Harrington and B. F. Tillson jointly arranged for the meeting and acted as charimen. This is the second meeting of the institute devoted to dust hazards, the subject being brought out into the open for the first time at last year's convention.

There are three general methods of combatting the dust hazard: (1) free use of water, in wet drills, in water curtains through which ventilating air passes, and in wetting down walls, floors and muck piles; (2) use of respirators by underground workmen; (3) use of dust-control apparatus on the rock drills. Advantages and disadvantages of each method were aired at the meeting.

Use of water favored

Extensive use of water as a dust-control medium was advocated by D. E. Cummings, Saranac Laboratory, Saranac Lake, N. Y. In outlining the silicosis problem, he stated that silicosis is dangerous only in connection with some other lung infection, such as tuberculosis. He further stated that silica dusts in combination with other dusts are more dangerous than silica alone, which is borne out by contentions of Dr. Jones of England that sericite particles are the true cause of silicosis, not pure silica. Mr. Cummings declared that dust particles over 10 microns in size (a micron is 1/25,000 of an inch) and those below ¼ to ½ micron in size are not so dangerous to the human lung as particles from 1 to 3 microns. A concentration of more than 5,000,000 particles under 10 microns per cu.ft. of air is considered dangerous. He stated that general ventilation is of prime importance in underground work, and recommended a minimum of 300 cu.ft. of pure air per minute for each workman.

An important point raised by Mr. Cummings was that engineering control of dust is not sufficient alone to combat the health hazard, but medical correlation is necessary. A later discussion revealed the inability of the average doctor to recognize silicosis from X-ray photographs, pointing out the need for not ordinary but expert medical correlation.

In the application of water this method is effective only if the dust particles are thoroughly wetted and only when pure, clean neutral water is used. Ditch water is worse than none, he declared. Water should be applied at every operation—drilling, blasting and mucking. The use of water curtains across headings was urged, as tests have shown that a single curtain has reduced the dust concentration of underground air as much as 65 per cent.

Blasting, Mr. Cummings declared, is the most potential source of dust. A water blast—a combination of water and high-pressure air released at the heading during and following a blast—is often effective. Drilling is next in importance in creating dust. He recommended the use of wet drills and the use of an auxiliary spray when collaring the hole, as usually the water is not operating through the drill at this stage. Drill holes should be blown with water, not air, to reduce the dust hazard.

The use of water as extensively as advocated by Mr. Cummings was seriously questioned in an active discussion. Several pointed out the undesirability of introducing so much water into the headings, both from the standpoint of creating excessive humidity and from the nuisance and safety angle of removing the excess water and the creation of slippery conditions underfoot. Others stressed the point that all dusts should be considered pathologically dangerous until proved innocent.

Respirators now approved

Respirators or filter masks worn by the workmen have in the past been regarded by many authorities as inefficient. Wm. Yant, director of the Bureau of Mines Laboratory in Pittsburgh, declared that the bureau is now testing respirators and giving its approval to those found satisfactory. Three makes so far have been approved. The trouble in the past has been the attempt to create an all-purpose mask, for dust, mists and fumes. Now the masks are being made for specific purposes and are approved as such. Though filter types only have been considered by the bureau so far, plans are now under way to test pressure or fresh-air types, though these are regarded as impractical for underground work by many authorities.

A good filter must be capable of trapping or straining out all harmful dust particles from the air breathed by its wearer, at the same time not restricting his breathing or making the wearing of the mask uncomfortable. These conditions are now being met, according to Mr. Yant, and the correct uses and proper changing of filter mediums are proving effective in protecting workers in dusty atmospheres. The service life of a respirator involves elements of practicability in the wearing and maintaining of the device, and indirectly elements of safety. This type of respirator is not an emergency device but is a part of the workman's equipment for doing his job safely. If the service life is short, the bother of changing filter elements will be reflected in the workman's attitude toward good maintenance and use.

TABLE I—EFFECTIVENESS OF DUST-CONTROL METHODS, BALMAT MINE

(Figures represent dust concentrations, millions of particles under 10 microns per cu.ft. of air)

	Dry Drilling	Wet Drilling	Kadco System
Drifting, 700-ft. level, 2 drills:			
General ir, 25 ft. from face	16.4	11.9	4.6
Breathing zone of drill runners	266.7	14.0	3.3
At exhaust of collector	.....	.....	2.0
Stoping in raise, 1 drill:			
General air in drift	1.9	7.1	24.0*
Breathing zone of drill runner	208.0	9.9	1.6
At exhaust of collector	.....	.....	2.6

*Due to previous blasting.

TABLE II—COMPARISON OF DRILLING SPEEDS AND LIFE OF DRILL STEEL, BALMAT MINE

Drifting

	Wet Drilling	Kadco System
Total footage drilled	2,137	2,111
Footage per piece drill steel dulled	7.13	15.20
Time, min. per ft. hole drilled:		
Setting up	0.386	0.431
Drilling	1.263	1.243
Changing steel	0.342	0.315
Lining in	0.480	0.542
Removing equipment	0.246	0.258
Delays	0.390	0.436*
Total time	3.106	3.226

Stoping

	Dry Drilling	Kadco System
Total footage drilled	786	1,763
Footage per piece drill steel dulled	7.08	12.16
Total time, min. per ft. hole drilled:		
Setting up	1.075	0.776
Drilling	1.971	1.466
Changing steel	0.261	0.254
Lining in	0.379	0.285
Removing equipment	0.342	0.333
Delays	1.543*	0.785*
Total time	5.570	3.899

* Includes scaling time.

Two papers presented at the meeting dealt with tests run on the newly developed dust-control system (Kadco system) for rock drills, conducted at the Balmat mine of the St. Joseph Lead Co. in St. Lawrence County, New York. This system, which has been described from time to time in *Engineering News-Record,* consists of hoods or traps that fit over the drill steel at the mouth of the drill hole, hose lines leading from the hoods to the collector, and a collector or separator where the dust is taken out of the air stream, discharging a hygienically safe effluent air. The entire dust content of a drill hole is removed through the system.

R. J. Mechin, of the St. Joseph Lead Co., described comparative drilling speeds, life of steel and over-all time requirements with dry, wet and Kadco systems of drilling in both drifting and stoping operations. The results, given in Table II, show a saving in time by the Kadco system over dry drilling, about equal time requirement when compared to wet drilling, and a considerable saving in steel over both dry and wet drilling. The life of drill steel was more than doubled when comparing Kadco to wet drilling.

But more important from a dust-control standpoint were the results of dust-sampling tests, made by the Metropolitan Life Insurance Co. and revealed at the meeting by J. W. Fehnel of that organization. Comparative dust concentrations with dry, wet and Kadco systems of drilling are given in Table I. A tremendous reduction in concentration, especially at the breathing zone of the drill runners, is apparent with the use of the control system.

Land Subsidence of 15 In. Follows Earthquake in Utah

AN EARTH SUBSIDENCE of 15 in. along a 28-mile length of Coast and Geodetic Survey precise level line resulted from the earthquake of March 12, 1934, in Utah, with the results of the settlement accurately determined by a resurvey of the line. In 1911 the C.&G.S. ran a line of first-order levels west from Brigham, Utah, toward San Francisco, establishing benchmarks at intervals of 3 to 5 miles along the line. The earthquake of March 12, 1934, developed surface indications of faulting across this line of levels in the vicinity of Kosmo, Utah, and a field party was ordered to rerun the line.

The leveling was started from the location where the surface indication showed the fault across the line of levels and was run in both directions until a check was obtained on the benchmarks placed in 1911. The maximum subsidence, as determined from the 1911 benchmarks, occurred at the monument that is about 0.2 miles east of Kosmo, along the line of the Southern Pacific Railroad tracks. The lowering of the benchmark at this location amounted to about 15.6 in. Checking the line to the west from this point the subsidence decreased to only about 1 in. at a distance of a little more than 4 miles and reduced to zero at the benchmark located about 10.5 miles to the west.

Checking the line eastward from the maximum subsidence, the difference reduced to about 4 in. in a distance of 7½ miles; the rerunning was discontinued after a distance of about 17 miles. The rerunning of the line and the establishing of the new elevations for the benchmarks was done by a party in charge of A. C. Thorson.

Progress and Possibilities in Concrete Discussed

Convention program of American Concrete Institute pictured the effect of current thinking with respect to such questions as special cements, vibration, more careful analysis, refined design and small house construction

MEETING in New York City for the first time in 25 years, the American Concrete Institute devoted the three days of Feb. 19-21 to a program reflecting the modern thinking and practices that are currently promoting change and improvement in the art. An unusually important meeting from both standpoints of attendance (550 registered) and interest, this 31st annual convention covered a program containing papers on the growing use of special cements, on the variability of standard cement to produce durable concrete, on architectural possibilities of concrete houses and of bridges, on new structural forms borrowed from European practice, on experiences with vibration as a means of placing concrete both for improvement in quality and decrease in cost, on a penetrating evaluation of design thinking and on other subjects of technical interest.

A discussion of the question of whether there should be two conventions a year produced little constructive thought from the floor of the convention, but brought out the sugestion of the board of direction that the Institute adopt a policy of annual conventions alternating between New York and Chicago, in April instead of February, with the addition of another two-day meeting in November, to be held in some locality where members are interested in building up a program. The only part of such a proposal that was made defiinite was the decision to hold the next annual meeting in Chicago.

P. H. Bates, of the Bureau of Standards, was re-elected president. The Wason Medal, given for the most meritorious paper of the preceding year, was awarded to Raymond E. Davis, Roy W. Carlson, G. E. Troxell and J. W. Kelly for a paper entitled "Cement Investigations for Boulder Dam with Results up to the Age of One Year." The Wason Medal for research was given to A. G. Timms and N. H. Withey for the work reported in a paper entitled "Temperature Effects on Compressive Strength of Concrete."

The annual dinner was featured by addresses by P. H. Bates, president of the Concrete Institute, and Edward J. Mehren, president of the Portland Cement Association. In line with the new methods and trends reflected by the convention program, Mr. Bates urged the Institute to be alive to the necessity for reorganizing its activities and methods to cope with the new and changing conditions. Mr. Mehren's illuminating address on "Concrete—Yesterday, Today and Tomorrow" pictured the parallel advances in concrete making, in cement manufacture and in design. In concrete making the remarkable improvement stemming from the work of Talbot, Richart and Abrams down through the introduction of weighing of all materials by the Iowa highway department, to recent methods of placing, including pumping and vibration was recalled. Vibration was characterized as the greatest single development since the discovery of the water-cement ratio law.

The field of cement manufacture experienced a gradual and steady improvement in the standard portland product from 1900 to 1920 followed by the important research which has produced high-early strength portlands, the discovery of the principal compounds of cements and the revival of many special hydraulic cements. In the field of design there was pictured a steady increase in knowledge, with improvement in appearance of structures and refinements in analytical methods and design procedure. Finally, as to the future, Mr. Mehren visualized concrete, because of its characteristic plastic nature, as having an unlimited field of development in providing more durable, beautiful and fireproof structures for a nation that in great part must be entirely rebuilt in much of its physical plant. He went so far as to predict the possibility that a volume-constant concrete may soon be produced.

Special cement trends

Increasing and heterogeneous talk about special cements was brought to a focus at last year's meeting of the American Society for Testing Materials when P. H. Bates (Bureau of Standards) suggested drawing up specifications for five types of hydraulic cements —portland, modified portland (containing not more than 5 per cent other material), portland-puzzolanic, fused, and natural—to meet one or more of four classes of service—moderate strength, low heat of hardening, sulphate resistance, and high-early strength. Although at the time this was considered by some to be a radical suggestion, Mr. Bates at this year's convention in a review of the special cement situation was able to point to actual use of so many special cements as to leave his "modest five types and four classes of use somewhat outdistanced." Also, these special cements are not new but only revived; actually the newest of the hydraulic cements is the standard portland. The special cements are being revived, in Mr. Bates' opinion, not so much because of failures with standard portland, but because of a belief that a good job can perhaps be made a better job by the use of some other type of cement.

If enough users want a new product, someone will produce it. Mr. Bates suggested to the cement manufacturers that they examine their costs, to see if they could make a profit on a given special cement. If they could, it would be good business to make it. If they found it uneconomical, they of course should not make it, but in addition they should not try to discourage others from making it. To the users, Mr. Bates issued a warning: Before adopting a special cement having a particular desirable property, study it carefully to see if the development of this property may not carry with it a major development of other less desirable properties.

Portland-puzzolan cements

The revival of interest in puzzolanic material as a constitutent of cement, particularly on the West Coast, is reflected in an extensive investigation of blended cements—portland puzzolans—at the University of California, the results of which were presented by Prof. Raymond E. Davis in a paper by himself, J. W. Kelly, G. E. Troxell and H. E. Davis. Puzzolan, as usually defined, is a siliceous material chemically active in the presence of lime, although in this investigation some inactive silicas were included. The types of puzzolan which were blended with high-lime portland cement—and in some cases with low-lime cement—to form some eighty blended cements were of five groups: (1) diatomaceous earths, (2) volcanic earths, (3) siliceous rocks, (4) clays and (5) limestones.

Interesting tentative conclusions with respect to about a dozen properties of the cements were presented by Prof. Davis, who warned that they might have to be modified as later results become available. More water is required for concrete made with portland-puzzolan than with straight portland cement. Concrete made with a blend of high-lime portland and puzzolan has a compressive strength only 75 to 95 per cent that of straight high-lime portland cement concrete but is stronger than low-lime portland cement concrete, with which it is more fairly comparable; the volcanic silicas produce the best results. Three-months standard mortar tests show a higher tensile strength for the blended cements; also the rate of increase in strength is more rapid, and the volume change is greater than for mortar made with the high-lime cement. Puzzolan cements show up better in strength comparisons in lean than in rich mixtures.

The portland-puzzolan cement, in addition to having a more rapid rate of heat loss, also generates a smaller total amount of heat than high-lime portland. This property was pointed out as being advantageous for mass concrete work. Volume change is somewhat accentuated with the presence of a puzzolan in the cement, but the increase is not significant. As a matter of fact, Professor Davis pointed out that the type of aggregate has much more effect than the type of cement, and later, in the discussion, Prof. C. H. Scholer (Kansas State College) made this statement more specific by stating that the importance of the aggregates on volume change is several hundred times that of the cement. The portland-puzzolan cements revealed a greater resistance to sulphate action, the diatomaceous earth blends showing up best in this respect.

The optimum amount of puzzolanic material for blending seems to average about 20 per cent, the exact amount depending upon the type of puzzolan used.

Cements compared

To determine the effect of brands and types of cement, an extensive investigation of the strength and durability of concrete made of 18 different cements, (thirteen of standard portland and five of high-early-strength type) has been carried out at Lehigh University. Compressive strength of 3x6-in. cylinders at 3, 7 and 28 days, using four different concrete mixes, was used as the criterion of strength, and the number of repetitions of freezing and thawing of similar cylinders required to produce a loss in weight of 25 per cent was used as an indication of the durability. Concrete made with the different brands of standard portland cement varied considerably both in strength and durability; the same was true of the high-early-strength cements. In general, durability was found to be independent of strength. Both qualities were independent of the chemical composition of the cement, indicating that the method of manufacture may have been the most important cause of the variation in quality. For the very lean mixes the high-early-strength cements gave higher durability than the standard portlands, but for richer mixes there was no difference.

In discussion P. H. Bates (Bureau of Standards) reemphasized the importance of method of manufacture, stating also that variation of the cement compound composition is a minor cause of variation in strength and durability of the concrete. The Lehigh investigation included a high alumina cement, which in every case produced concretes of less durability than did the portland cements. Prof. Scholer (Kansas State College) cited directly opposite experience. Prof. Scholer also questioned the use of a freezing and thawing test as a measure of durability, stating that it was impossible to get consistent results.

Vibration

Characterized on several occasions at the meeting as the greatest development in the concrete art since Abrams discovered the water-cement ratio law, and made the subject of a symposium of ten papers, vibration of concrete received due attention. The ten papers resulting from a questionnaire sent out by a special committee under the chairmanship of A. E. Lindau, furnished a wide cross-section of opinion on the practical aspects of vibration. Some of these opinions and their sources follow.

A. E. Lindau (Chicago)—From available reports, vibration apparently effects a saving in manpower of 40 to 70 per cent, a saving in cement of 5 to 10 per cent, and adds from 5 to 10 per cent to form cost. The recent trend has been toward internal vibrators.

F. V. Reagel (Missouri Highway Department)—Vibration equipment development still lags behind the needs of the field. Two types of vibration equipment have been used in Missouri—screeds which ride on the forms and a pan which rests directly on the concrete. Mixes of ¾- to 1½-in. slump have been placed. Core tests taken across a slab show variation in strength, with low results where pavers deposited the concrete. This would indicate need for equipment which will deposit concrete in a wider ribbon. Since present pavement vibrators do not always affect concrete at the bottom of the slab, there is indicated a need for the development of an internal type of vibrator for highway service.

T. E. Stanton (California Highway Department)—Internal vibration has been specified for most of the 1,000,000 cu.yd. of concrete required for the San Francisco-Oakland Bridge. A small electric vibrator has been used for confined places, and a larger air vibrator for the larger masses. The small electric vibrator runs at 4,500 r.p.m. The 30-in.-long, 3-in. diameter, internal vibrator of the rigid type runs at 10,000 r.p.m., while an internal vibrator of the flexible-shaft type runs at 8,000 r.p.m. A three-speed throttle on one of the internal vibrators has proved very useful. Large vibrators have handled from 25 to 40 cu.yd. of concrete per hour, this concrete having a slump of 1 to 4 in.

Lewis H. Tuthill (Colorado River Aqueduct)—Vibration will not redistribute aggregate in the mix. It should be relied upon only to move the concrete vertically and to compact it and not to make it flow in the forms. Experience seems to indicate that small vibrators should have high frequencies and small amplitude, and large vibrators relatively lower frequencies but larger amplitude. On the aqueduct it has been the experience that vibration improves the concrete in all properties that are a function of water content. Finishing costs have been reduced. Forms need be no better nor more costly than for other types of work.

F. H. Jackson (Bureau of Public Roads)—Whereas by usual methods a mix of 2½ in. slump is required, with vibration this may be reduced to 1 in. Water has been reduced as much as ½ gal. per sack of cement by the use of vibration. Also, aggregates may be added and the cement reduced about ½ sack per cu.yd. Nevertheless, few states have specified vibration because the economies and strength gained do not seem great enough. The bureau, however, is in favor of vibration because of the increased density resulting. A tentative specification for vibrated concrete would require a 1-in. slump, minimum sand for workability, same water-cement ratio as for unvibrated concrete and an increase in aggregate content up to a maximum of 5 per cent by weight. Experience has shown that ordinary pavement concrete with high sand content can actually be harmed by vibration. New distributing equipment is needed for moving dry concrete from the mixer to the forms. Equipment manufacturers are to be commended for their work in developing vibration, in view of the general apathy of highway engineers toward it. For state highway department experience with vibration he referred to ENR April 26, 1934, p. 528, and May 3, 1934, p. 561.

Ben Moreell (Bureau of Yards and Docks, U. S. Navy)—Vibration is more extensively used in France than in this country. A piece of equipment that is different from any used in this country is known as a floating vibrator. It consists of a simple bucket within which the vibrating element is placed. The bucket is set on the bottom of the forms, and concrete is poured around and over it. It is then allowed to work its way (by vibrating) to the top of the pour. Its rate of progress is said to average about 13 ft. per hour. Success has also been had with a surface vibrator for mass concrete in which the base is made up of rod mesh. This is claimed to be effective in interlocking with the large aggregate and in producing a rough surface for good bonding of the next pour.

Sam Comess (Army Engineers, Rock Island, Ill.)—On lock and dam work in the Mississippi River concrete has been placed by buckets and by pumping. For the former method two vibrators have been used, one on either side of the pile working toward the top. For pumped concrete, one vibrator has been sufficient, operating at the point of discharge. For mass work, a vibrator weighing about 75 lb. has proved most efficient. Concrete with a slump of ¾ in. has been used. Internal vibrators are operated about 6 in. from the face of the form with good results. Some attempts to fix an end point for vibration have been made by observations of the amount of air bubbles; this has been successful to a degree.

T. C. Powers (Portland Cement Association)—In attempting to secure a measure of the efficiency of a vibrator, it is possible that permissible reduction in water content of the mix might be utilized.

W. R. Johnson (Tennessee Valley Authority)—On the Wheeler Dam, 12 to 36 yd. of concrete per hour have been placed in the forms with internal vibrators. For the large open forms the batches are from 8 to 16 yd. and require two-man vibrators. For the mixes used, the sand is reduced to 31 per cent by weight (as against 35 per cent for unvibrated concrete), the mortar content is kept the same, and the aggregate content is increased. It seems probable that developments in vibrators will be in the direction of higher speed, greater amplitude and lighter weight.

Laboratory Tests—One of the few laboratory investigations that have been made of vibrated concrete was carried out at the University of Wisconsin by Prof. M. O. Withey. The tests involved 188 6x12-in. cylinders, which were set in a frame to which a small electric vibrator was attached. Among the conclusions were the following: (1) vibrated concrete made with 7 to 8 per cent of cement is dense, watertight and has a strength of 3,500 lb. in 28 days; (2) dry-vibrated mixes of 1 part cement to 13.2 parts of sand and aggregate are superior in all respects to 2-in. slump, hand-puddled concrete containing 25 per cent more cement; (3) mixes of 1:10, 1:11.6 and 1:13.2 withstood 150 cycles of freezing and thawing, exhibiting strength of 91 to 95 per cent of moist-cured specimens; (4) concrete made of 1:10 mix showed no leakage under a pressure of 40 lb. per sq.in; (5) vibration permitted the use of a drier mix, lower cement content, coarser grading, and produced a denser, more volume-constant, watertight and durable concrete; (6) for a speed of 3,600 r.p.m. 1 min. of vibration was required, while for a speed of 6,500 r.p.m., only 20 sec. was required. Power consumption of the electric vibrator increased with increases in amplitude and frequency.

Modern concepts and structures

Three papers, comprising one session, were concerned with some significant examples of modern thinking and practice in the concrete field. In a paper entitled "Why Continuous Frames?" Prof. Hardy Cross (University of Illinois) subjected design thinking to a penetrating philosophical analysis. "Continuity may be a considerable nuisance to the designer," said Professor Cross, "but artfully handled, it not only ceases to be a source of danger but in most cases points the way to overcoming the handicap of dead weight and massive appearance and lends itself to the full utilization of the plasticity of concrete by the development of more graceful forms of construction." Taking as an example the familiar structural form commonly called a rigid frame, he pointed out how by coring out the soffit of the girders, material is saved, dead load is reduced and the structure is made more graceful. Further, he suggested the consideration of the thin section at the center as a hinge, making for more ready and more accurate determination of moments. In this connection, too, he urged laboratory determinations of permissible deformations of reinforced concrete members, such strains often being more significant than strength. "We may have if we prefer—and I often do very much prefer—the essential action of a hinged or discontinuous type in a structure which is everywhere continuous in its material."

Turning to the one-story rigid-frame building, Professor Cross pointed out that since the chief function of the frame is to carry dead load, maximum economy results from reducing and rearranging this dead load, carrying as much as possible of it by direct compression in the columns and not by bending in the roof girders. As for the economy from redistributing dead load, Professor Cross pointed out that a beam with a parabolic soffit tapering to a small depth at the center requires one-twelfth as much concrete and one-fourth as much reinforcement as a beam of constant section throughout. In tier building frames, which necessarily are continuous, economy from this redistribution of dead load is not a major factor because much of the dead load is in the slabs and not in the girders.

In general, Professor Cross' discussion was a plea for a new attitude on the part of the designer, in which he approaches his problems not with the question of "How does this structure act?" but with the question, "How do I want it to act?" Having settled upon this, the problem is one of proportioning the structure to meet these requirements.

Thin Shell Roofs—The construction features of the thin concrete shell roof on the Hayden Planetarium in New York were presented by R. L. Bertin, chief engineer of the White Construction Co. As the first important example of the Zeiss-Dywidag design in this country, the roof represents one of the outstanding modern uses of concrete. With a diameter of 80½ ft., the roof has a thickness of only 3 in. above a line 9 ft. above the springing line and 3½ in. thick below this line. A circular rib, 12 in. wide and 18 in. high, of stone concrete, serves as a ring girder at the base of the dome. The balance of the dome is of gunite, reinforced with three layers of ¼- and ⅜-in. rods, and shot against 1½ in. slabs of rock cork, to serve as interior insulation.

(Pictures and a brief description of this dome appeared in *ENR*, Dec. 13, 1934, p. 774.)

Articulated Concrete — Extensive studies of the Mesnager hinge, a semi-articulated joint for concrete arches used to a considerable extent in France, have been carried out by the Bureau of Yards and Docks, U. S. Navy, under Lieut.-Commander Ben Moreell. In addition to designing a three-hinged roof 1,070 ft. long and of 110-ft. span for a ship-model testing basin, Lieut.-Commander Moreell has had six specimen hinges tested by the Bureau of Standards and has built and tested to destruction a one-quarter size model of the large roof. The tests of the Mesnager hinges by the Bureau of Standards, carried out by D. E. Parsons and A. H. Stang, included seven specimens or blocks representing a short length (34 to 64 in.) of an arch barrel or rib. Either 9½x12 in. or 9½x15 in. in cross-section, each specimen contained a hinge formed by a 4-in. open gap across which the longitudinal reinforcing bars (bent to an angle of 30 deg.) are continuous. On some of the specimens the bars within the gap were bare, while in others they were embedded in mortar, the least covering being ½ in. thick. Lieut.-Commander Moreell pointed out that Mr. Mesnager had considered this concrete covering of the bars to be only for corrosion protection, but that the tests showed that it contributed greatly to the bending resistance of the joint, giving it 7.5 to 11.5 times as great resistance to rotation, as well as increasing the thrust resistance of the specimens from 2 to 3.2 times.

The test of the quarter-size model of the roof arch (27½-ft. span and 6-ft. rise) gave a better indication of the efficiency of the hinges. Failure occurred at the quarter-point and not at the hinge, and under a load greatly in excess of the design load. Measured deflections showed the construction to have exceptional rigidity for an articulated structure.

Varied aspects of concrete

Industrial floors — For heavy-duty floors, to withstand the traffic of industrial trucking, the Eastman Kodak Co. utilizes special construction, according to L. F. Fairchild, structural engineer for the company. The specification for this floor required a 5,500-lb. strength at 28 days; a silica sand graded from ⅜ in. to 98 per cent retained on the No. 48 sieve; a fineness modulus of 4; 3½ gal. of water per bag of cement; and 3-min. mix. The resulting no-slump mix is spread with wood tampers and screeds, after which a power trowel is applied, followed by hand troweling for smoothness. The floor is cured from seven to ten days before use.

Bridge architecture—The work of the New Jersey state highway department in building pleasing bridges is outstanding. Morris Goodkind, bridge engineer, reviewed the necessary architectural considerations, analyzing the principal ones of unity, harmony, continuity and proportion as they have been applied to numerous concrete bridges, varying from pile trestles to high multiple-span arch structures.

Residences—The possibilities of concrete in low-cost houses were discussed in a series of papers by engineers of the Portland Cement Association. R. R. Zipprodt reviewed recent examples of special designs ranging in cost from 18 to 45c. per foot; R. E. Copeland presented results of tests at the University of Illinois on monolithic walls, and W. G. Kaiser considered new results with precast joists for residence-floor construction. Useful data for those interested in fireproof residence construction were contained in all of these papers.

John J. Early, who has achieved such remarkable results in architectural concrete, described a small house he has recently built in suburban Washington wherein thin prefabricated slabs, using quartz aggregate and sand in mosaic patterns, were attached to a timber frame. Using the technique of careful aggregate gradation, a dry mix vibrated into 2-in.-deep forms and made drier by extracting further water, wire-brushing of the surface to expose the aggregates, which are then washed with muriatic acid, Mr. Early produced 32 slabs 9 ft. high and 4 to 10 ft. wide with fluted surfaces and black, red and yellow trim. These slabs, trucked 10 miles to the building site, were erected with a small A-frame hoist and attached to poured concrete colums (at the joints of the slabs) by dowels encased in rubber hose, to permit movement of the slabs from temperature changes. The foundations of the house were also of concrete of the exposed aggregate type.

Concrete Inspection — Two papers setting forth the views of two concrete specialists of the qualifications of an inspector brought out some interesting contrasts. A. Burton Cohen, consulting engineer, New York, urged that technically trained men versed not only in field requirements but also in research and design, be used as inspectors. R. B. Young, testing engineer of the Hydro-Electric Power Commission of Ontario, while agreeing with the essentials outlined by Mr. Cohen, felt that the same results could be obtained with other than college-trained men. An inspector, in addition to knowing the technical aspects of the job, must have a personality which permits him to get what he wants without friction. Also, he must have the confidence of the workmen. In many respects this confidence is more important than the confidence of the contracting management. For this reason a construction foreman or superintendent often makes an excellent inspector. Conversely, the young engineer often has difficulty in securing the confidence of the men, too often he does not believe that the inspection job is good enough for him, and he does not apply himself to its requirements carefully enough. Higher salaries are a first requisite.

Testing Mass Concrete—A paper by R. F. Blanks and C. C. McNamara outlined the program of mass-concrete research conducted by the Bureau of Reclamation at its Denver laboratories in connection with the design and construction of Boulder Dam. In general, the paper contained the detailed statistical data upon which the conclusions given by Mr. Blanks in *Engineering News-Record,* Nov. 22, 1934, p. 648, were based.

Building Code — The committee charged with revision of the "building regulations for reinforced concrete" under the chairmanship of A. W. Stephens, reported substantial progress by its twelve sub-committees.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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Acoustics Popularized

PRACTICAL ACOUSTICS FOR THE CONSTRUCTOR—By C. W. Glover. Cloth; 6x9 in.; pp. 468; line cuts, halftones and tables. Published by Chapman & Hall, Ltd., London. Price 25s.

ACOUSTICS and the related topic of the transition of sound and of vibration through walls and structural framework are involved subjects at best, and much of the literature relating to them is highly specialized. In this book the author has endeavored to present the general principles in a concise and easily understood form. Special attention is given to the interests of students, and each chapter contains a series of exercises for the guidance of the scholar. A valuable element of the book is a 28-page bibliography of books and articles on acoustics, vibration and noise. Many types of acoustical materials are illustrated and described.

British Unemployment

THE BRITISH ATTACK ON UNEMPLOYMENT—By A. C. C. Hill, Jr. and Isador Lubin. Cloth; 6x9 in.; pp. 325. Published by The Brookings Institution, Washington, D. C. $3.

FOR A DOZEN YEARS Great Britain has had severe unemployment, and since 1929 it has had the added burden of the world depression. On the average, one worker in seven was out of a job in the period 1923-1933, and one in five during the five years from 1930 to 1934. A few industries, as shipbuilding, have for years had unemployment ratios up to 55 per cent. Public-works contracting since 1929 has ranged from 25 to 45 per cent. These figures define the problem whose attempted solution is the theme of Hill and Lubin's notable study, a study that bears on some of our most serious current problems.

Beginning with the 1921 depression, a series of measures to correct or relieve unemployment conditions was put in force by the British government. The problem had actually been recognized ten years before, and a system of unemployment insurance was instituted in 1911, but the decade that included the strenuous war period did not put it to test. When the system was extended in 1922 to cover several times as many workers as before, and the stress of declining industrial activity came upon it, it broke down. Only step-by-step relaxation of its requirements, spreading of benefits and ever larger governmental contributions kept it alive.

Other measures were national employment exchanges (about one-fourth effective), public-works grants, assisted emigration and relief payments. This whole group of measures, however, was aimed at relief alone, without any recovery or trade-stimulating purpose. In particular, the public-works effort lacked the recovery objective, and the authors pertinently say: "No sizable volume of work was thrown into the breach during intensified depression periods. . . Neither the size of the program nor its timing were such as to afford it an opportunity markedly to affect the general industrial situation. . . Whether a vast public-works program can stimulate the industrial pulse of a nation remains yet to be proved"—so far as the British experience goes, presumably.

Designed originally to provide temporary relief of a temporary condition, the relief measures developed into systems for dealing with a permanent oversupply of workers, as is most clearly expressed in the emigration schemes initiated shortly after 1922. The entire British policy as outlined by the authors appears to have been framed to accomplish a forcible shrinking of the country's working army to suit the existing standard of living and the established industrial system.

Interesting information will be found

also in what is said of unemployment insurance, especially because of its inclusion in the security legislation now before Congress. The authors show how, when unemployment became heavy, the system disintegrated into a general dole system. Because benefits were paid to "persons who logically should not have been considered as unemployed"—in short, because of official laxity and racketeering by beneficiaries—"the insurance system became the vehicle for the distribution of public relief funds."

After delivering this powerful lesson on the apparently inevitable debasement of an insurance system, the authors nevertheless return hopefully to defense of unemployment insurance: "In the last analysis it is unemployment, not unemployment insurance, that demoralizes." In this remark they may be giving the key to the problem: that the objective must be prevention rather than cure of unemployment.

Structural Design

STRUCTURAL THEORY AND DESIGN: An introduction to Theory—Second Edition. By Hale Sutherland and Harry L. Bowman. Cloth: 6x9 in.; pp. 318; numerous diagrams. Published by John Wiley and Sons, New York, Chapman & Hall, Ltd., London. Price $3.50.

STRUCTURAL DESIGN IN STEEL—By Thomas Clark Shedd. Cloth; 6x9 in.; pp. 560; halftones and line cuts. Published by John Wiley & Sons, Inc., New York, Chapman & Hall, Ltd., London. Price, $5.

PRACTICAL DESIGNING IN REINFORCED CONCRETE—Part II—By M. T. Cantell. Cloth; 6x9 in.; pp. 291; photographs, diagrams and tables. Published by E. & F. N. Spon, London, and Spon & Chamberlain, The Engineers Book Shop, New York. $4.50.

THE FACT that each of these three new books covers a fundamental division of structural design—namely, theory, steel design and concrete design—justifies grouping them together in the same review. The second edition of "Structural Theory" by Professors Sutherland and Bowman improves this valuable text greatly by adding the modern methods of rigid-frame analysis developed by Prof. Hardy Cross, i.e., moment distribution and the column analogy. The first edition included an unusually effective presentation of such concepts, theorems and methods of structural analysis as the method of work, the method of elastic weights, a variation of the method of elastic weights known as the bar-chain method, Williot-Mohr diagrams, method of least work, slope deflection, influence lines, moment area and reciprocal deflections; the second edition retains this presentation in complete form. Rigid frames are given attention comparable to that accorded trusses, in line with modern trends. Wind stresses in tall building frames is the subject of a chapter, as is space framework.

Professor Shedd's new text, planned for a three-semester course, attacks the problems of structural-steel design by what might be termed a synthetic method. First, a chapter is devoted to each of the four essential parts of a structure—fluxural members, tension members, compression members and connections—and these are then combined as they apply to buildings in one chapter and to bridges in another. A unique and instructive feature of the book is the inclusion of 24 plates of design calculations presented as leaflets from a practicing designer's notes. A chapter on structural welding and three sets of specifications for railway bridges, for highway bridges and for buildings, respectively, complete the book.

Mr. Cantell's book on "Practical Designing in Reinforced Concrete" has the combined characteristics of handbook and text, in that it is largely made up of design examples worked out in sufficient detail not only to demonstrate the principle but to outline procedure as well. The author has practiced and taught civil engineering and architecture in England, Canada and America. Structures treated include hollow columns, walls and wall columns, retaining walls, foundation slabs, stairs, roofs, tanks, towers, swimming pools, bins and water and sewer pipe. The present book is Part II of a three volume series, the last volume to cover chimneys, dams, bridges, domes, etc.

Miscellaneous Notes on Booklets and Reprints

"THE ENGINEER'S DUTY AS A CITIZEN," a statement by Roy V. Wright as an outline for discussion course at Newark College of Engineering has been republished by the college, 245 Market St., Newark, N. J.

"PRINCIPLES AND PRACTICAL METHODS OF DEVELOPING WATER WELLS" is the title of a bulletin recently compiled and published by Edward E. Johnson, Inc., St. Paul, Minn. In its 32 pages it discusses the hydraulics of wells in sand and gravel formation and the various methods of developing wells.

A SYMPOSIUM ON OUTDOOR WEATHERING of metals and metallic coating is available in booklet form from the American Society for Testing Materials. The papers included cover performance data obtained from the extensive outdoor weathering tests carried out by the society's committees and were presented at the Washington regional meeting of the society a year ago. Copies of the 113-page booklet can be obtained from A.S.T.M. headquarters, 260 S. Broad St., Philadelphia; $1.25, in heavy paper; $1.50 in cloth.

"ANALYSIS OF RIGID-FRAME CONCRETE BRIDGES" has been republished as a third edition by the Portland Cement Association. The new edition includes, among other things, a new chart and a new formula by which moments may be determined quickly without the use of frame analysis. There is also a method of correcting moments in frames and a method of determining stresses in double-reinforced concrete sections subject to combined stressing and axial thrust. Copies may be obtained from the Portland Cement Association, 33 W. Grand Ave., Chicago.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

AIR CONDITIONING AND OZONE FACTS—By E. W. Riesbeck, M.E. Leather. 5x8 in.; pp. 352; photographs, diagrams and tables. Published by Goodheart-Wilcox Co., Inc., Chicago. $3.50.

ANNUAL REPORT OF THE STATE TAX COMMISSION (New York)—1933—Cloth; 6x9 in.; pp. 380; tables. Published by Dept. of Taxation and Finance, Albany, N. Y.

ELEMENTS OF SPECIFICATION WRITING—By Richard Shelton Kirby. Cloth; 6x9 in.; pp. 163. Published by John Wiley & Sons, Inc., New York. $2.

HYDROGRAPHIE—By Friedrich Schaffernak. Paper; 7x10 in.; pp. 438; diagrams and tables. Published by Julius Springer, Vienna. RM 46.50.

A MATHEMATICAL TREATISE ON VIBRATIONS IN RAILWAY BRIDGES—By C. E. Inglis. Cloth; 7x11 in.; pp. 203; line drawings and tables. Published in U. S. A. by the Macmillan Co., New York. $7.50.

MOTOR VEHICLE TAXATION IN NEW JERSEY—Report by William D. Ennis. Paper; 6x9 in.; pp. 199; diagrams and tables: Stevens Institute of Technology, Hoboken, N. J.

NATIONAL RESOURCES BOARD—Buckram; 9x12 in.; pp. 455; halftones, maps, line drawings, tables. Published by Superintendent of Documents, Washington, D. C. $3.75. Also published in 5 parts in paper binding. Part 1—Report of Board, Findings and Recommendations, 25c. Part 2—Report of Land Planning Committee, 35c. Part 3—Report of Water Planning Committee, $1. Part 4—Report of Planning Committee for Mineral Policy, 15c. Part 5—Report of Board of Surveys and Maps, 20c. . . . *See ENR, Dec. 20, 1934, p. 796 for an abstract of this report.*

NAVEGACION Y PUERTOS, Anexo a la Memoria de Obras Publicas—1930-34—Paper; 7x10 in.; pp. 230; photographs, diagrams and tables. Published for the Republic of Colombia by Editorial el Grafico, Bogota.

PRESSURE PIPE OBSERVATIONS AT PANJNAD WEIR—By A. N. Khosla. Cloth; 5x8 in.; pp. 88; photographs, diagrams and tables. Published in a limited edition by Central Board of Irrigation, Simla S.W., India.

REPORT OF THE MISSISSIPPI VALLEY COMMITTEE OF THE PUBLIC WORKS ADMINISTRATION—Cloth; 9x12 in.; pp. 234; halftones and maps. Published by Superintendent of Documents, Washington, D. C. $1.50. . . . *See ENR, Jan. 3, 1935, p. 19, for an abstract of this report.*

ROAD AND RAIL IN FORTY COUNTRIES—By Paul and A. Albitreccia. Cloth; 5x8 in.; pp. 455; tables. Published by Oxford University Press, London. $6.

UNITED STATES GOVERNMENT MANUAL—Cloth; loose leaf; 8x10 in.; pp. 572. Issued by The National Emergency Council, Washington, D. C. $2.

ENGINEERING NEWS-RECORD

Volume 114, No. 9

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Editorial and Publishing Offices at 330 West 42d Street, New York

February 28, 1935

The Last Bucket

WHEN the last bucket of concrete was deposited in the main body of Boulder Dam last week, it signalized the completion of placing 3,300,000 cu.yd. in the incredibly short period of 21 months. At the time construction of the main dam was started, in June, 1933, eighteen months ahead of original schedule, the period of 33 months allotted for its completion required that concrete be placed at the rate of slightly more than 100,000 cu.yd. per month. Instead, the rate of placing reached the monthly average of 160,000 cu.yd., and the dam-building time was cut one-third—nearly a full year. Thus, on the basis of the original schedule the entire project has now been advanced about thirty months. These condensed statistics epitomize the most remarkable mass-concreting work on record. It is a story of well-planned and adequate equipment, of a construction program and organization thoroughly synchronized and capably managed. Once more enduring credit reflects on the contractors and engineers.

Warning From Abroad

IT IS FORTUNATE that active exchange of views in Congress on the pending construction bill affords time for considering the effects of this remarkable measure thoroughly. During this consideration thought may well be given to the experience that was had in Great Britain in carrying on stimulated production for work-relief purposes. The notable report of Hill and Lubin on "The British Attack on Unemployment," issued a few weeks ago by the Brookings Institution, gives a significant warning of what may result from ill-adjusted procedure in such emergency construction. The authors say, "The policy of using construction projects as a means of providing relief for the rank and file of the unemployed, rather than for jobless building-trades workers, has led to a swelling of the numbers attached to the public-works industry"—in fact, more than a doubling, from 123,000 in 1923 to 164,000 in 1927 (when the work-relief program had been in operation for some time) and to 290,000 in 1932. This unhealthy expansion was brought about in spite of the fact that even in the earlier years the labor complement of British public-works contracting was more than ample, as shown by an unemployment ratio during the years 1923-1926 approaching 20 per cent. By 1930 the ratio had reached 25 per cent, and in 1932 it exceeded 40 per cent. Thus, attempts to create employment produced unemployment. Figures of this kind give a clear picture of the disorganizing effects that may be anticipated if the contemplated federal construction program proceeds under the relief procedure that has been vaguely indicated. It is true that such parts of the new program as deal with improvised field operations of primitive type can and should use groups of unemployed even though belonging to other trades and crafts. But that part of the program which is to operate more directly for recovery cannot follow this course, at the risk of grave harm.

In Defense of Engineers

WITH THE INCREASING ACTIVITY of engineers in matters of general public concern, including both large construction undertakings and the manysided emergency activities of the day, there is evident need for the profession to be ready to defend its members against unjustified attack, political or otherwise. In view of this need it is a gratifying development that the American Society of Civil Engineers by recent action has decided to assist and defend members who may be removed from their position on unsupported charges and without proper hearing. Presumably such defense will also be available under other circumstances, where serious charges are made even though dismissal may not be immediately at issue. Such action in defense of the professional good name necessarily involves risk, but the risk is well worth taking. The past year alone brought a number of cases in which such professional support and assistance in upholding an engineer's reputation would have been of value. The harm that can result from unjust attack comes quickly, and defense, to be of value, must be prompt.

What Price Joints

METHODS OF PROVIDING JOINTS for pavement movement have been tossed back and forth by opinion since concrete-slab construction for pavements assumed importance. At no time has a satisfactory joint been an assured product of designers and constructors. The joints that have been built are failing to give smooth travel, proper transfer of loads and reasonable durability. The fundamental reason for this disappointing result is that paving engineers have refused to pay the price of a good joint. As is made clear by R. E. Toms in this issue, joints that will meet the structural requirements of modern pavements are not cheap devices; adequate provision of expansion and construction joints for a mile of road runs into a round sum of money. The dowel-bar joint has been a failure commonly because only half or a third enough dowels were used, and often because the joint filler adopted was the one that cost least for material and placing. Frequently cheapness is the sole criterion of joint structure. Until practice frees itself wholly from such hampering doctrine the concrete road will continue to be marked by uneven slab ends, split slabs and joints that spall, crush and crack.

Professional Organization

ENGINEERING SOCIETIES in seven states have voted to affiliate with the National Society of Professional Engineers; in two other states affiliation is being put to vote of the membership. Thus in less than a year after its organization the new society has grown to a membership of 4,000. The same emphasis on professional rather than technical problems stands out in even the most casual review of the proceedings of recent society meetings, both state and national. As yet the direction of the new movement is difficult to determine, and ideas as to just what is wanted from professional societies are ill formed. Under these circumstances enthusiastic reception is accorded to a new society unhampered by tradition. Those who would direct society activities along new lines see in it an opportunity for the development of their ideas; those who are discontented with the accomplishments of the older societies turn to it in hope that it may attain to fuller realization of their ideals. Rapid growth in membership thus becomes a challenge to those who have promoted the National Society of Professional Engineers. The society quickly must put into concrete form the desires of those who are giving it their moral and financial support. It must also sift out of those ideas the ones that it can support and those that it must reject as impractical or inappropriate. Thus it will build up a definite program, without which it cannot look forward to continued support.

Must the Power Be Wasted?

JUDGE GRUBB'S decision in the suit brought by stockholders of the Alabama Power Co., to enjoin the sale of transmission lines and other property to the Tennessee Valley Authority raises two interesting questions: first, what is surplus power at a government dam for river regulation or for navigation; and second, when does the government go into business?

The TVA is building a navigation dam at the Wheeler site that will concentrate the fall of many miles of river at that point. Development of two or three hundred thousand horsepower is possible at the site, only a small part of which will be required for the locks, floodgates, etc. Judge Grubb holds that the federal government may develop enough power to meet all navigation and flood-control requirements and may sell the surplus that results from variations in its demands, but he attempts to distinguish between this power—the difference between peak-load requirement and current instant requirements—and the power in excess of peak-load requirements; he holds that when the government sells the former it is within its constitutional functions, but that when it sells the latter it is going outside and is entering into business. Is such a distinction possible or desirable? Does not the right to dam a river to improve its navigability carry with it the right—and possibly the obligation—to convert the potential power into useful power?

Judge Grubb holds that the government goes into business when it sells power in excess of the surplus resulting from operations incident to navigation improvement. But in so doing he raises a still more fundamental issue of whether the government does not go into business when it leases a power site under the provisions of the federal power act. If the federal government were to lease the Muscle Shoals plant to the Alabama Power Co. at so low a figure that it could enter into competition with some neighboring power company, would not the government still be going into business? In other words, the mere act of leasing or selling a power site, or selling falling water, as is done at Boulder Dam, puts the federal government into business just as much as does the sale of power at Tupelo.

The two questions raised by Judge Grubb's decision are fundamental to our whole power policy. If his reasoning is followed, it would seem to require that all power at navigation dams in excess of that used to operate the locks must be wasted.

To Make the Construction Bill Effective

NOW THAT the Senate has returned the construction bill to committee for revision, opportunity is at hand to give it such form as should make the measure successful. In its original form its effectiveness was highly questionable. Concededly designed to serve the three distinct purposes of relief, work relief and recovery construction, the bill neither stated these purposes nor prescribed the requisites for their secure attainment—a fatal omission in view of the complex questions involved. This omission also gave cause for the needless disagreement on wage rates that halted the bill.

Aside from the $880 million assigned to direct relief, the bill devotes $4,000 million to a year's construction work, which is to engage the 2¼ million men now on work-relief together with an additional 1¼ million, or 3½ million men in all. To make this one-year campaign possible requires that useful work widely distributed and in large volume be ready, and that it be started and prosecuted at unprecedented speed without loss of soundness.

Undoubtedly many of the 3½ million workers, unfitted for normal construction operations, must continue in work-relief activities. The full scope of the work at hand, then, includes (1) existing work-relief, (2) the stock of ready local projects on file with the PWA or waiting to be filed, a total of several billions of dollars, (3) federal work, including highway construction and grade-crossing elimination, both of them valuable quick work-producers, and (4) resumed private construction using investment money, if this can be induced to participate in the recovery program by a reasonable incentive, whether interest guarantee or income-tax remission. This last type of construction ought by no means to be overlooked, for it offers a means for multiplying the recovery effect by drawing on private capital as does the Federal Housing Act.

By specifying these four types of work, assigning to them definite sums and prescribing the basic procedure for each, the bill can be made an efficient, flexible measure offering all necessary freedom in administration.

There will be no dispute as to the propriety of continuing work relief under the subsistence-wage system now in force and used last winter by the CWA, so long as this wage system does not trespass on regular construction work. On the other hand, the real recovery work—highway work, city and state construction of PWA type, and major federal undertakings, which necessarily are the main part of the program—cannot be done efficiently other than under normal bid and contract methods, with free employment of labor and under actual prevailing wages.

Thus it is not a question whether prevailing or limited wage rates shall apply. Both have their proper place in the program. To eliminate the apparent conflict, it is only necessary to remedy the lack of clearness of the bill by distinguishing between relief work and recovery work and to prescribe procedure accordingly.

At the same time, Congress in revising the bill should not lose sight of the critical importance of speed and workable procedure in carrying out the program. Guided by the experience had with CWA and PWA, and making use of the fact that local responsibility can be made the guarantee of soundness and success, those charged with the task of revision have a clear path toward making the measure workable and fair. Whatever technical advice they may require to define its detail provisions for most successful result is known to be at their command.

CURRENT NEWS

Concrete Placing Completed on Boulder Dam

ON Washington's Birthday, 21 months after concreting operations started on Boulder Dam, the last bucketful of concrete was placed in the main body of the structure. This concludes the placing of 3,300,000 cu.yd. in the main dam, and there remains only the building of the roadway, parapet and architectural features to finish out the crest.

With the placing of the last concrete in the main body of Boulder Dam, it is possible to compare the carrying out of this work with the schedule originally planned. According to the original specifications, concreting operations were to start December, 1934, and be completed in August, 1937. This schedule planned an average rate of placing of about 100,000 cu.yd. per month for the 33 month period. However, diversion tunnel driving and foundation excavation work was advanced by Six Companies Inc., the contractor for the project, far ahead of original schedule so that in 1932 a new schedule was established, which called for the beginning of concreting operations July, 1933, and completion in April, 1936. This revised schedule moved the date of completion ahead about sixteen months, maintaining the same length of time for carrying out the work.

Actual concreting operations on the dam itself began June 6, 1933, which was 18 months ahead of the original schedule. The rate of concreting was increased materially and the work has now been concluded in a 21-month period as compared to 33 months provided in the original and revised concreting schedule. This increased concreting output raised the average monthly production to a figure of more than 160,000 cu.yd. for the entire 3,300,000 cu.yd. in the main body of the dam.

Based on this date, which marks the completion of concreting, the project is now 2½ years ahead of the schedule called for in the original specifications and a full year ahead of the revised schedule.

Remaining work

The power house building will be completed about July 1, and according to the present program, two 82,500-kva. generators will be installed and placed in operation about January, 1936, with two additional units ready for operation a few months later. If this program is maintained, power from the Boulder Dam project can be supplied to the city of Los Angeles in June, 1936, and to the Metropolitan Water District in January, 1938, the completion date for the aqueduct.

Additional work to be done before the Boulder Dam project is completed includes the finishing of the penstock installation in the outlet tunnels and the completion of the intake towers, The 372-ft. concrete intake towers, which contain the gates for controlling the flow of water from the reservoir, will be completed in June of this year.

Since the bulkhead gate was dropped and storage was begun on Feb. 1, the water has risen to a depth of 75 ft. behind the dam and backed up a distance of 25 miles into the reservoir site.

Fast Progress Made on Ft. Peck Diversion Tunnel Pilot Headings

What is believed to be a world's record for tunneling progress was made on the pilot headings of the four diversion tunnels for the Ft. Peck dam in Montana when in the 31 calendar days from Jan. 16 to Feb. 15 an average progress of 1,337.5 ft. was made in each of the four headings, driving from one portal only. The pilot headings are 16 ft. 4 in. wide and 14 ft. high, timbered with 10x10-in. sets spaced from 5 to 8 ft. Each set consists of 8-ft. posts and a five-segment arch, with 2-in. lagging between sets. Material through which the tunnels are being driven is Bearpaw shale, requiring timber to be carried to the face following each blast. Power augers are used to drill the blasting holes instead of the conventional rock drill. Muck is transported to the portals in cars and is then transferred to a belt conveyor system for disposal. During the month's progress reported above, the following footage was made in each tunnel: No. 1—1,263 ft.; No. 2—1,347 ft.; No. 3—1,420 ft.; No. 4—1,320 ft. The maximum 24-hr. run was 59.5 ft. The tunnels, 6,160 ft. long, will later be enlarged to 26 ft. diameter inside of concrete lining. The Mason & Walsh Co., New York, is contractor, working under the direction of the U. S. Corps of Engineers.

Water District Gets Authority To Take Over San Jacinto Tunnel

Authorization for the Metropolitan Water District of Southern California to proceed with the construction of the San Jacinto tunnel of the Colorado River aqueduct project, pending a permanent injunction hearing, has been given by the United States District Court with the withdrawal of a temporary restraining order against the district. The temporary injunction against the district restraining it from interfering with operations of Wenzel and Henoch, contractors, was ordered by the court and cancelled on the urgent plea of the district to let the work continue. Officials of the district are to appear Feb. 28 on an order to show cause why a permanent injunction, sought by the Wenzel and Henoch Co., should not be granted. The Wenzel and Henoch Co. recently was relieved of the tunnel contract and the work was taken over by the district.

The suspending of the Wenzel and Henoch contract by the district last month was reported in *ENR*, Jan. 14, 1935, p. 141, and the actual taking over of tunneling operations was noted Feb. 21, 1935, p. 298.

Wage Rate Issue Sends Works Bill Back to Committee

(Washington Correspondence)

SHARP Senate attack upon the $4,880,000,000 work relief bill last week culminated in the adoption of the McCarran amendment for prevailing wage rates, after which the bill was sent back to the Appropriations Committee for revision. Indications are strongly toward a new attempt to split off the $880,000,000 for relief purposes during the rest of the fiscal year and to let the public works feature await later action. An alternate plan is to appropriate $1,880,000,000 or $2,880,000,000. Meanwhile the FERA has been assured $176,000,000 which will last for more than a month at the present rate of expenditure and relieves Congress of moving hurriedly.

McCarran amendment

The McCarran amendment passed by the close vote of 44 to 43 due to the combined efforts of Republicans seeking to harass the Administration, the laborites, and Senator Huey Long. Previously, Senator Glass warned that the President would veto the measure if the Senate accepted the McCarran plan. He read a letter from the President assuring that the federal government would act to keep the works fund from depressing wage levels. As adopted, the amendment exempted the Civilian Conservation Corps from maintaining prevailing wage rates. The Senate also adopted several of the Appropriations Committee amendments including the proviso that full advantage be taken of the facilities of private enterprise wherever practicable.

Recommitment of the measure was resorted to by administration leaders as a move toward meeting the President's wishes. Subsequently, Senator Robinson declared that prevailing wages would increase the cost of the program by more than $2,000,000,000 and would make it impossible to terminate the dole system. He stated that the decision would be thrown to the people but Senators on both sides of the controversy claim that their mail has confirmed their stand and that they have no intention of shifting.

Paul V. Betters, director of the United States Conference of Mayors, said that unless a work relief bill is enacted, proponents will stage a mobilization and demonstration in Washington.

Speaker Byrns predicted that the House will stand by the President. This would make it possible to work out a compromise in conference. Most Washington observers believe that a substantial appropriation for public works will be provided after the oratory subsides. One explanation of the recommitting of the bill is that the Wheeler and Thomas inflationary amendments were about to come up so that it was deemed expedient to postpone debate on this subject until the administration's strategists are prepared to handle it.

Plan for Building Super-Highways Is Works Program Item

(Washington Correspondence)

CONSTRUCTION of a national network of super-highways is tentatively included in the Administration's announced plans for spending the $4,000,000,000 work relief appropriation. The ideal visualizes wide, straight trunkline highways extending from Canada to the Gulf and from the Atlantic to the Pacific coast. A highway built on the 39th parallel, for example, would connect both seaboards without touching any large city on the route. In its practical application, however, the project must allow for considerable deviation to include existing highways or projected routes which the states desire to develop in the same general direction.

Surprised by the disclosure of the plan, President Roosevelt, in press conference, stressed the question of whether state plans will permit development of the super type of highway. Slighting the interests of particular states would, of course, arouse opposition to the whole scheme. This was one of the big reasons why the President desired to secure the huge appropriation before disclosing his plans. President Roosevelt's remarks last week revealed, however, that much study has been given to the project.

Broad outline of plan

In its broad outline, the plan contemplates acquisition of rights-of-way perhaps half-a-mile wide. On the assumption that property flanking the highway would greatly increase in value, its subsequent sale or lease would largely defray the cost of purchase and construction. The President explained that the principle of excess condemnation had been suggested to eliminate the element of "pure luck" by which the farmer whose property happens to occupy the right-of-way would reap the profit that, in the President's opinion, should go to the state or local government which builds the road.

The first hint of super-highway scheme was revealed when Rear Admiral Christian J. Peoples, chief of the Treasury Department's procurement division, told a congressional committee, which was dubious concerning the cost of the huge works program, that part of it might be defrayed by the sale of gasoline by the government. When this served only to raise a storm of opposition to such competition with private business, the admiral said that, instead, the government might derive revenue from "concessions" along highways.

Since then President Roosevelt has discussed the plan with New Deal leaders in Congress and is reported to be enthusiastic regarding its potentiality for creating employment. When questioned last week, he said that the object in highway construction should be to employ as much manual labor as possible without being wasteful.

Probably the first route to be selected would be from Vermont to the Gulf. This would include the sky line highway already built through Shenandoah National Park and the partially constructed road traversing the Great Smoky region to the south. State highway engineers along the route recently were called into conference by Secretary Ickes.

IN WASHINGTON

By Paul Wooton

Washington Correspondent

At the rate protests are being received, early resurrection of the work-relief bill is anticipated. When it emerges again from committee, however, it is expected that specific mention will be made of the types of projects that may be undertaken. Other conditions for the expenditure of the fund probably will be added before it returns to the Senate floor.

When Public Works Administrator Ickes releases his promised breakdown by states of all pending applications for public works money it is expected to add measurably to the pressure on Congress for additional funds. Pending applications for Public Works money aggregate more than $8,000,000,000.

While the House Committee reduced to $25,000 the maximum limit for modernization loans it is believed that the $50,000 limit carried in the bill as introduced will be restored before the bill becomes a law. Construction and other interests believe the higher limit is necessary to secure maximum results from a program for industrial modernization.

Agricultural Adjustment Administration officials have reached the conclusion that no further increase of farm income may be expected from reducing production. Industrial recovery is essential to further increases in farm prices, they believe, and they expect to cooperate in efforts to bring that about.

Administration leaders in Congress will expedite the consideration of legislation providing for the extension of the National Recovery Administration. They realize that uncertainty with regard to extension is making it difficult for the coded industries.

Competitive Sale of TVA Power Held Illegal by Federal Court

In a verbal decision based on the constitutionality of the federal government's rights "to conduct any proprietary business unless it did so in a way that was tied to some expressed or implied constitutional grant of power," Federal Judge W. I. Grubb, district court of Birmingham, Ala., rendered on Feb. 22, declared that the sale of electric energy by the Tennessee Valley Authority in competition with private utilities was illegal. Suit for an injunction to restrain the TVA from selling power, generated at plants on the Tennessee River, to municipalities and rural areas, was brought by a group of holders of Alabama Power Co. preferred stock.

Judge Grubb held that the contract entered into Jan. 9 between the Alabama Power Co. and the TVA, which would transfer certain transmission lines to the authority, would put the TVA in the power utility business, and was illegal.

The judge also made permanent his temporary restraining order, according to report, enjoining fourteen towns in the northern part of Alabama from accepting or expending PWA funds for the construction of electric distribution systems.

The judge distinguished between the right of the government to dispose of electric energy that is a distinct byproduct or "surplus" resulting from some other governmental activity, and the production and sale of electric energy as the principal feature of the governmental activity. In the present case the judge held the power sale to be more than a surplus which placed the TVA in the category of a governmental agency competing with private utilities.

The ruling did not touch on the constitutionality of the act creating the TVA.

Counsel for the TVA stated that notice for appeal to the higher federal court would be filed immediately.

Connecticut Civil Engineers Discuss Wide Range of Subjects

WITH a two-day program covering a wide range of civil engineering topics, the Connecticut Society of Civil Engineers held its 51st annual meeting on Feb. 19 and 20, at New Haven, Conn. Included in the subjects on the program were modern lightweight railroad equipment, utility valuation, land reclamation and water-supply engineering. The attendance was in the neighborhood of 200.

Modern railroad equipment

The new light-weight coaches, recently put into service on the New York, New Haven & Hartford Railroad, and the three-car articulated stream-line trains now being built for that railroad, were described by J. C. Hassett, mechanical engineer of the railroad company. The new coaches have been in service for several months and represent a decided departure from the traditional railroad coach design. Much of the design effort was directed toward a saving in weight and resulted in a coach weighing 1,143 lb. per passenger, a considerable decrease over the lightest coach heretofore used by the road. Each coach seats 84 passengers. By providing each truck with its own braking system it was possible to eliminate the large air-brake cylinders, with a resultant saving in weight. The monitor roof has also been omitted. The cars are air-conditioned. The exterior has been designed to prevent as few re-entrants as possible, the windows being flush with the sides.

A new three-car articulated stream-line train is being constructed by the Goodyear Zeppelin Co. for the railroad. It is to be used on the Boston-Providence run when put into service. Each end of the train will be provided with motive power, consisting of diesel engines, electric generators and electric motors. In operation, the train will not rely upon a high prevailing speed for the saving in time between termini, but rather will gain its time largely through faster acceleration.

The Clark dike

The Clark dike, built recently to reclaim an extensive low area in a bend of the Connecticut River at Hartford, was described by Roscoe M. Clark, city engineer. The area reclaimed is roughly a triangle three miles long and one mile wide at the

(Continued on p. 334)

PWA Inventory of Available Projects Reaches High Total

MORE than $8,500,000,000 worth of public works projects has been reported to the PWA in its national inventory of available work which might be undertaken in the proposed works relief program. The inventory will not be completed until March 1, according to Administrator Ickes, but the preliminary total includes nearly 60,000 specific projects of every character and description according to lists which have been prepared by PWA state engineers and state planning boards. Virtually all of the projects reported are new proposals, although there is some overlapping.

No analysis has been made to determine the proportion of federal and non-federal projects and all of the reports are preliminary and subject to revision. A cursory examination of the lists indicates that most of the projects would fall into the non-federal classification to be carried out by states, municipalities and other public bodies.

Summary by states

The preliminary report released by the PWA which included all states but Pennsylvania, tabulates the number of projects and the estimated cost by states, as follows:

State	No. of Projects	Est. Cost
Alabama	2,981	$168,459,830
Arizona	46	53,805,537
Arkansas	1,468	241,928,362
California	970	130,064,410
Colorado	351	32,710,350
Connecticut	477	44,301,033
Delaware	65	14,550,763
Florida	1,833	115,034,410
Georgia	725	32,251,518
Idaho	824	76,112,546
Illinois	149	14,340,200
Indiana	316	47,664,337
Iowa	1,267	35,925,165
Kansas	1,619	158,401,414
Kentucky	2,021	267,847,114
Louisiana	217	147,011,950
Maine	108	42,079,100
Maryland	892	131,095,250
Massachusetts	425	94,293,101
Michigan	4,565	646,438,052
Minnesota	705	43,528,638
Mississippi	3.330	260,262,973
Missouri	469	26,197,301
Montana	1,139	170,863,823
Nebraska	474	31,974,920
Nevada	166	8,595,481
New Hampshire	463	43,001,212
New Jersey	1,754	1,408,722,364
New Mexico	611	51,917,132
New York	742	1,267,645,177
North Carolina	675	66,204,613
North Dakota	1,090	14,635,862
Ohio	3,870	540,854,794
Oklahoma	1,692	184,418,071
Oregon	2,102	460,237,888
Pennsylvania	....	....
Rhode Island	369	79,581,938
South Carolina	163	11,695,841
South Dakota	597	29,357,038
Tennessee	4,813	357,055,671
Texas	3,025	247,899,093
Utah	1,547	74,950,540
Vermont	532	42,317,445
Virginia	1,586	106,641,501
Washington	2,820	261,440,168
West Virginia	653	69,616,850
Wisconsin	2,624	176,574,815
Wyoming	328	41,080,751
Total	59,658	$8,589,510,578

Project classification

An analysis of the types of projects with the exception of Pennsylvania and Colorado (Colorado report received too late to be included in the breakdown) indicated that there were more street and highway projects reported than any other type. The second largest listing was for school buildings and the grade crossing elimination projects totaled 2,200 with an estimated cost of $333,750,000.

The breakdown of projects into type of work follows:

Type	Number	Est. Cost
Waterworks	3,698	$595,044,788
Sewers	4,182	675,484,487
Streets and highways	16,033	1,822,563,835
Heavy engineering structures	1,862	1,803,888,743
School buildings	13,048	638,662,524
Other buildings	6,423	639,447,400
Power (electric, gas, etc.)	1,115	326,810,136
Airports and landing fields	456	29,489,119
Grade crossings	2,296	333,756,593
Recreation	4,307	199,380,722
Flood control and irrigation	2,629	1,186,466,210
Miscellaneous	2,837	404,655,490

Merrimack Valley Authority Planned by State Legislation

Legislation which would create the Merrimack Valley Authority is to be introduced in the legislatures of Massachusetts and New Hampshire, following a conference between officials of these two states and the federal government. The proposal includes a $40,000,000 improvement development in the Merrimack Valley. The state legislation is intended to put the plan in a position to go ahead when federal approval is given.

The program will include truck line sewers, recreational and housing centers and projects to control soil erosion. Present plans call for complete federal financing, with $30,000,000 to be spent in Massachusetts and $10,000,000 in New Hampshire.

Minnesota Engineering Society Meeting Has Large Attendance

WITH one of the largest registrations in years and a prevailing spirit of optimism, the fortieth annual convention of the Minnesota Surveyors' and Engineers' Society was held in St. Paul Feb. 21 and 22, followed by an equally well attended convention meeting of the Minnesota Federation of Architectural and Engineering Societies the following day. The technical programs were varied in coverage, but emphasized recent activities in engineering and public problems. C. N. Robertson was elected president of the Minnesota Surveyors and Engineers Societies with C. L. Methven, vice-president and H. E. Chard, secretary. George E. Loughland was elected president of the Minnesota Federation of Architectural and Engineering Societies with E. D. Corwin vice-president and Catherine Feucht, secretary.

Registration discussed

The question of value of registration for surveyors, engineers and architects was the subject of greatest discussion at the meeting. Minnesota has had a registration act for many years, but until an amendment was added by the legislature of 1933, it was of small practical value to the profession. During the present convention representatives of all the technical societies of the state met with the registration board to review complaints and discuss existing confusion. As a result of the meeting the Minnesota Federation of Architectural and Engineering Societies, which sponsored the original act and amendments, appointed two committees; one on the classification of engineers, architects and surveyors, with standards of qualifications, and another committee to whom complaints relative to administration might be made. The purpose of this second committee is to eliminate the difficulty of bringing to light violations of the registration act, individuals being hesitant to report directly to the board because of the possibility of being called as a witness. These complaints can now be rendered to the committee who will then make an independent investigation and present the case to the board.

Technical program

George M. Shepard, chief engineer, city of St. Paul, outlined the plans for the removal of the historic Minnesota Transfer bridge, a viaduct 2,000 ft. long, which has long been a bottle-neck for highway traffic between Minneapolis and St. Paul. S. E. Lang, engineer of tests, Minnesota highway department, presented a paper on road soil science with special consideration for the local conditions on highway construction in glacial drift, peat bogs and attendant problems of heaving.

Soil erosion work in the southeastern part of Minnesota and the results obtained in conserving soils were discussed by Orville H. Hosmer, field technician of the Erosion Control Service. Housing, work of the state planning board, developments in sewage disposal and the progress in the application of codes to the industry were also features of the program. "Weather Cycles and Lake Levels" was the subject presented by Jesse W. Schuman, consulting engineer, Minneapolis, and the conclusion was drawn that some of the Minnesota lakes which are now considered unusually low have been completely dry in former cycles. The construction features of the Fort Peck Dam were presented in a paper by Capt. C. H. Chorpening, Corps of Engineers, U. S. Army.

Baltimore Plans Water Tunnel To Cost $5,300,000

Construction of a $5,300,000 additional water tunnel between Loch Raven and the Montebello filtration plant, a part of Baltimore's water supply system, is planned. The city solicitor has given the Public Improvement Commission an opinion to the effect that the money for the work can be taken from the fourth water loan, passed in 1931. The loan was for a total of $7,500,000 but only $1,000,000 has been expended.

The tunnel is included in a list of PWA projects for which federal funds are sought, but because a special committee of engineers has held that the work should be carried out without delay the city officials are proceeding on the theory that federal funds will not be available. Should they be allocated to the project the financial plan can be altered.

Progress is Slow on Area Agreements With 20 Approved

(Washington Correspondence)

ALTHOUGH public hearings have been held on 96 proposed area agreements to fix wage rates and hours of labor for skilled employees under the construction code, beginning with the hearing held on the New York City mason contractors agreement May 1, 1934, only 20 agreements have received the approval of the President, as required to become effective. There has been an almost continuous succession of public hearings since the middle of August, but due to the difficulties in proving adequate representation, approvals have been exceedingly slow, and some apprehension has been felt as to the effectiveness of this method of stabilizing wage conditions in the hundreds of separate construction centers throughout the country.

Uncertainty over NRA

The thought has also been expressed that the termination of the National Industrial Recovery Act on June 16 of this year and the uncertainty as to the form of its possible extension may also be a factor in deterring many construction groups from undertaking the very involved procedure necessary to obtain an area agreement, yet several hundreds of such agreements have been submitted to NRA, and as fast as they can be brought into line with the requirements, public hearings are scheduled, and the necessary supporting information collected which is required before approval.

Of the 20 agreements approved to date, 13 are under the Painting, Paperhanging and Decorating Division; 2 each under the Mason Contractors and Electrical Contractors Divisions, and one each under the Plumbing Contractors, Plastering Contractors and Tile Contractors divisions.

Variation in wage rates

The basic skilled labor rates in agreements vary considerably, the rate for painters in Philadelphia being 85c. per hour, 90c. in Wilmington and $1.25 in Miami. Skilled electrical workers in Detroit receive $1.25 per hour and in Chicago $1.50 for class A, and $1.00 for class B. The masons rate in New York City is $1.50, and in Tulsa $1.25; while plumbers in Denver receive $1.14 per hour as compared with $1.10 minimum fixed by Chapter X of the code, for a maximum week of 35 hours; and tile layers receive $1.12 per hour in Philadelphia.

The maximum hours per week are the same as the maximum fixed by the code, or 40 hours except as to plumbers in Denver, painters in Wilmington, Salt Lake City and St. Paul with 35 hours per week the maximum, and painters in Miami limited to 30 hours.

Of the 96 proposed agreements which have been heard at public hearing, since May 1, 49 are under the painting division, 11 under the electrical contracting division, 2 under the heating, piping and air conditioning division, 9 under the plumbing division, 3 under the plastering division, 3 under the roofing division, 7 under the masons division and 8 under the general contracting division.

Driving of Chicago Water Tunnel Completed on Feb. 25

On Feb. 25 the last heading of the Chicago Ave. water tunnel in Chicago was holed through with by a blast touched off by Mayor E. J. Kelly. The main tunnel runs under the lake for 3 miles and inland west in Chicago Ave. 5½ miles to Central Park Ave. where it branches north and south to pumping stations on the west side of Chicago. The work has been done by force account supervised by the construction division of the city engineer's staff. A description of lining operations will be published in *Engineering News-Record* at an early date.

Illinois Towns Required to Plan Sewage Disposal Works

Danville, Ill., has been allowed a period of 90 days by the state water board to formulate and submit plans for a satisfactory sewage treatment system to prevent pollution of the Vermilion River. The board also allowed the city of Marshall 120 days in which to submit plans for abating the pollution of Big Creek, into which the city sewage empties. A sewage treatment and disposal system is required.

Postponement of action is probable as both cities are to be given the preference to seek P.W.A. funds to finance these projects.

Wisconsin Engineers' Annual Meeting Discusses Technical Subjects

UNLIKE several other state societies which had annual meeting programs devoted almost entirely to professional status, the Wisconsin Engineering Society devoted its annual meeting Feb. 21 and 22 at Madison almost wholly to technical subjects, with a wide range of coverage. The matter of professional standing came up in a brief discussion on the proposed amendment to the existing civil engineers licensing law by which electrical and mechanical engineers would be included. Daniel W. Mead strenuously objected to the proposal to license engineers in a wide variety of subdivisions. In Florida, it was stated, 25 different branches are recognized. The matter has been activated by the Milwaukee Engineering Society and a title has been entered in the state legislature, but impossibility of getting harmony has delayed preparation of the amendment to the bill. Opinion seemed to indicate that nothing would likely be accomplished at this session. There was little discussion of joining the National Society of Professional Engineers, although a committee will look into it.

Technical program

The technical program covered the following subjects: A historical review of the early land surveys and surveyors' activities in Wisconsin. An old-time surveyor, Harry C. Hall, Rhinelander, recounted early-day experiences and made a plea for preservation of monuments, which are disappearing so fast that all will be gone in 25 years. He suggested that counties and cities appropriate annually at least $500 for resetting monuments. Last year a bill to revise and consolidate the provisions relating to platting lands and recording plats was discussed thoroughly. The bill has now gone the rounds of societies and interested organizations and represents a compromise in some desirable features. The bill as now set up is in effect an excellent codification and consolidation in one place of numerous scattered references. Vernon Hamel, an engineer lawyer, has handled the compilation and is seeing it through the legislature.

Methods of handling sewer records were outlined by A. L. Boley, president of the society and city engineer of Sheboygan. He instanced a saving of $5,000 in designs of an extension made possible by the existing records. In speaking of trench work he said that all contractors are required to maintain plank covers over trenches until the city relays the pavement; such relaying is not undertaken until inspection by rod insertion indicates the backfill has consolidated.

Beach erosion was discussed in two papers: Sidney M. Wood outlined a theory that permeable groins are more likely to retain and build up sand fills than solid piers. Pictures were shown of such construction at Kenosha and Sheridan Park at Cudahy on Lake Michigan, where interlocking concrete segments were used; much accretion took place after a year's time. E. A. Howard, supervising engineer of the Milwaukee County Regional Planning Department, described the shore protection work at Sheridan Park carried on by CCC camps, consisting of making and placing the concrete segments in groins, reshaping the 50 to 100-ft. bluffs to eliminate or minimize surface erosion, and draining off subterranean water with tile pipes leading from sand pockets or strata to the water's edge. Beach erosion has been progressing at an average of 2 ft. per year in this park.

Recent foundation theories were outlined by A. E. Cummings, Raymond Concrete Pile Co., who discussed sampling, load tests, relation of small to large area tests, settlement prediction, both of short and long duration. He appealed to engineers to make available settlement data as all structures not on rock settle some. While much laboratory work has been done and theoretical analyses made, field results (rarely available) are essential as checks.

Many tests on masonry, mostly brick and concrete columns, made in the University laboratory were described by Prof. M. O. Withey.

The Upper Mississippi River navigation project was outlined by Capt. R. E. Coughlin before the joint session with the Madison Technical Club. This combined meeting has become an annual affair attended by several hundred engineers and technical men of the city and university. Capt. Coughlin stated that the roller gates at Rock Island were allowed to freeze in completely during the recent cold weather and then are opened successfully without use of the electrical heating apparatus.

Officers elected for the ensuing year are as follows: President, H. F. Yanda; vice-president, R. M. Connelly; trustees, C. A. Wiepking and Henry Traxler; secretary-treasurer, Ray S. Owen, Madison.

Connecticut Civil Engineers Hold Annual Meeting

(Continued from p. 331)

base. The dike is designed to withstand a flood stage in the river of greater than 30 ft.

The dike as built is about three miles long. The material used consisted of a fill of the silty sand excavated from the area to be reclaimed, backed up on the shore side by a fill section of sand dredged from the river. The river face of the dike is paved with stone. The composite section of the dam was decided upon because of the unsuitability of the highly permeable river sand as the sole material. The meadow silt was found to be capable of making a fill 70 times as watertight as the sand.

Structural aluminum

A discussion of structural aluminum and its applications to the construction industry was presented by J. P. Growden of the Aluminum Co. of America. Mr. Growden described the several aluminum alloys available for structural elements. In general, they weigh about one-third as much as steel, and have a modulus of elasticity also one-third that of steel. However, the thermal expansion is twice as great. Structural aluminum is resistant to corrosion, but cannot be considered as corrosion-proof.

Hartford's additional water supply project was described by Caleb M. Saville, manager and chief engineer of the Hartford Metropolitan Water District. The new supply is the third to be used to supply the Hartford district. It is to be drawn from the east branch of the Connecticut River.

The general principles of valuation of public utility properties were discussed briefly by E. L. Taylor, chairman of the Connecticut Public Utilities Commission.

The early iron industry in Connecticut was described by Herbert C. Keith and Charles Rufus Harte, engineer of the Connecticut Company. A brief outline of FERA activities in Connecticut was presented by F. Perry Close, state engineer, FERA.

At a business meeting the society elected W. Howard Sharp, of Windsor, president for the ensuing year. Other officers elected were: Vice-president, Benjamin H. Palmer, Jr.; second vice-president, Arthur W. Bushell; secretary-treasurer, H. Jackson Tippett. Joseph P. Brown was named director for three years.

Dimitri P. Krynine, of Yale University, received the annual prize given by the society for the best paper by a member appearing in the 1934 annual report.

Buffalo Served Show-Cause Order In Regard to River Pollution

On Feb. 19 the New York state department of health issued an order compelling the city of Buffalo to show cause on March 11 why the sewage pollution of Niagara River should not be terminated immediately. Health commissioner Thomas Parran, Jr., stated that he appreciated Buffalo's efforts to clean up its sewage pollution problem through having the legislature now in session pass a bill enabling it to use PWA funds to build a sewage disposal plant.

For some months a controversy has been under way in Buffalo in regard to the financial phases of providing a sewage treatment plant. The plan as presented to the state legislature would authorize the city to construct a sewage disposal system by means of $10,000,000 to be raised by local assessments and an anticipated $5,000,000 by PWA aid. Opposition to the plan has been brought by taxpayer groups.

The show cause order issued by the state health department was accompanied by a statement by Commissioner Parran which cited the wave of pollution that traveled down the Niagara River several weeks ago following the release of an ice jam. Pollution waves have occurred three times within the past two years and have subjected the water purification plants located on the river to an unreasonably heavy load.

To Repair Defective Chicago Sanitary District Sewer

Contract for repair of the 3,320 ft. of so-called defective 5x6¼-ft. Harvey sewer for the Sanitary District of Chicago which caused PWA Administrator Ickes to issue disquieting press releases last summer were executed Feb. 14 with the contractor, S. A. Healy Company. (*ENR*, Aug. 30, 1934, p. 286.) The supplemental contract calls for grouting to refusal at 90-lb. pressure to fill voids back of the sewer ring. Grout pipes were originally inserted every 8 ft. All loose materials, honeycomb surfaces are to be removed and any portions of existing concrete that proves defective during the grouting process is to be replaced. After the work has been completed an inner lining of 3,000-lb. concrete 6 in. thick is to be placed in the walls and arch and keyed into the invert.

The lining is to be placed at the contractor's expense and $15,000 is to be deducted from his payments as a sum agreed upon as the additional cost to the Sanitary District of pumping sewage through the smaller sewer section. Further deductions are to be made for extra engineering, inspection and tests which have been incurred.

SOCIETY CALENDAR

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual meeting, Chicago, March 12-14.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Cincinnati, Ohio, May 6-10.

AMERICAN SOCIETY FOR TESTING MATERIALS, regional meeting, Philadelphia, Mar. 6; annual meeting, Detroit, June 24-28.

SOUTHWEST ROAD SHOW AND SCHOOL, eighth annual meeting, Wichita, Kan., March 5-8.

INDIANA SECTION, American Water Works Association, Indianapolis, March 7-8.

GREATER NEW YORK SAFETY CONFERENCE, sixth annual meeting, March 5-7.

PENNSYLVANIA SECTION—NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, meeting in Philadelphia, March 8.

NEW YORK SECTION, American Water Works Association, spring meeting, Albany, March 21-22.

FLORIDA SECTION, American Water Works Association, West Palm Beach, March 27-30.

CANADIAN SECTION, American Water Works Association, London, Ont., March 27-29.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, winter meeting, Albany, Mar. 2.

NEW JERSEY SEWAGE WORKS ASSOCIATION, twentieth annual meeting, Trenton, Mar. 21-22.

Personals

Walter E. Willard, resident engineer for the Ohio department of highways in Hamilton County, has been appointed Eighth Division engineer.

Major F. K. Newcomer, Corps of Engineers, has been transferred from Fort Leavenworth, Kansas, to the office of the chief of engineers, Washington, D. C.

Major J. S. Bragdon, Corps of Engineers, has been transferred from Washington, D. C., to New York as assistant to the division engineer, North Atlantic Division.

Lt. Col. B. C. Dunn, Corps of Engineers, for three years district engineer in Jacksonville, Fla., has been transferred to the office of the assistant secretary of war.

Lt. Col. H. A. Finch, Corps of Engineers, has been transferred from the divisional office at San Francisco to Fort Lawton, Wash., effective next October.

W. F. Brown, former chief engineer, Vang Construction Co., Pittsburgh, Pa., is now serving as contract plan engineer for the Allegheny County Authority at Pittsburgh.

Lt. Col. F. B. Wilby, Corps of Engineers, has been ordered transferred from Washington, D. C., to the station of division engineer, Gulf of Mexico Division, New Orleans, effective in August.

H. L. White, Terre Haute, Ind., assistant engineer, state highway commission of Indiana, is on leave of absence to fill a temporary appointment as instructor in civil engineering at Rose Polytechnic Institute during the absence of Prof. R. E. Hutchins.

W. H. Powell, engineer, Greater Vancouver Water District, Vancouver, B. C., is the recipient of the Gzowski award of the Engineering Institute of Canada for his paper on the First Narrows Pressure Tunnel, which appeared in the journal of the Institute.

C. A. Seifried, Wyoming state highway department, and **H. T. Person**, assistant professor of civil engineering, University of Wyoming, have been appointed members of the Wyoming examining board for engineers. The state engineer is the third member of the board.

Lt. Col. John N. Hodges, Corps of Engineers, district engineer for the Second New Orleans District, has been transferred to St. Louis to serve as divisional engineer for the upper Mississippi Valley division. Preceding his work in New Orleans, Colonel Hodges had been district engineer of Memphis, Tenn., and has had long familiarity with Mississippi river problems.

L. W. Wallace, vice president of the W. S. Lee Engineering Corp., Washington, D. C., and for many years executive secretary of the American Engineering Council, has been made director of equipment research of the Asociation of American Railroads with headquarters in Chicago. From 1906 to 1917 he was a member of the faculty in the engineering department at Purdue University, and in close contact with the research work which that institution did in the mechanical equipment of railroads and locomotive design.

Ambrose Swasey is the recipient of the 1935 Washington award of the Western Society of Engineers. The award was made Feb. 20 and was conferred upon Mr. Swasey "for his distinguished contribution as a builder of instruments, institutions and men." For more than half a century the firm of Warner & Swasey, Cleveland, Ohio, has been making special precision machinery, specializing in the field of astronomy and optical instruments.

Obituary

Joseph P. Hodgson, well known contractor and engineer of British Columbia and a past president of the General Contractors Association of Vancouver, died in North Vancouver, B. C., Feb. 13, at the age of 54. He was president of Hodgson King & Marble, general contractors.

Charles Voetsch, engineer in the Denver headquarters of the Bureau of Reclamation, died in Denver, Feb. 7, age 57. He was a native of Germany and received his technical education in that country. He had extensive experience in hydroelectric and hydraulic design and prior to his connection with the Bureau of Reclamation, he had been with the U. S. Engineers on a survey of the Tennessee River.

Hersey Monroe, an employee of the U. S. Geological Survey for 55 years, died at his home in Washington, D. C., Feb. 17, age 67. Born in Lake City, Fla., he came to Washington and entered government service as a junior clerk at the age of 12, continuing his studies at the institution which became George Washington University. Mr. Monroe was in charge of the mapping program for the Shenandoah National Park and, as a result of his years of experience was considered one of the pioneers in topographic engineering.

Ralph D. Hayes, for the last five years New York state commissioner of canals and waterways, died Feb. 21 in a New York City hospital at the age of 54. Mr. Hayes was born in New York and was a graduate of Clarkson College of Technology. He served for a brief period with the U. S. Geological Survey and from 1904 to 1907 was engineer of state highways in New York. From 1908 to 1922 he served on the barge canal construction work and for the succeeding three years was in charge of canal operation and maintenance in the Albany district. For the next two years Mr. Hayes was deputy commissioner and engineer assistant and in 1930 was appointed commissioner of canals and waterways, heading the division of canals and waterways in the department of public works.

CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING awards total $22,762,000 for the week, with both public and private awards higher than during the two preceding holiday-interrupted weeks. Private work totals $4,763,000 and public work $17,999,000 of which $1,968,000 is federal and $16,031,000 state and municipal.

Highway awards at $7,088,000 make this the third highest week of this year. All classes of work are higher than a week ago except earthwork, irrigation and drainage at $230,000. Bridge awards total $2,818,000; waterworks, $1,310,000; sewerage, $1,643,000; public buildings, $4,680,000; commercial buildings, $1,848,000; industrial buildings, $1,625,000.

The larger awards include: 10-story apartment house for Concourse Development Corp., New York, N. Y., $500,000; completion of power plant and service connections, Willard State Hospital, Willard, N. Y., $455,000; South Ward Building for Homer G. Phillips City Hospital, St. Louis, Mo., $494,000; post office, El Paso, Tex., $550,000; highway lettings, $549,000 and $651,000 by Texas, $552,000 by Louisiana, $928,000 by Missouri. Other of the larger awards include: Randalls Island, Little Hell Gate and Harlem River piers for Tri-Boro bridge, New York, N. Y., $804,000; completion of Fillmore-Lovejoy St. Water Drain, Buffalo, N. Y., $726,000.

Bonds sales for new capital reached $1,325,000 for the week and by the RFC of PWA issues totalled $3,035,000, a transfer from federal to private financing. PWA allotments outstanding decreased $44,000 on non-federal work and increased $1,390,000 for federal work. The result of rescissions, reductions, increases, reallotments and changes from loan and grant to grant allotments reduced the state and municipal allotments outstanding by $4,688,000 and increased private loans outstanding by $3,319,000.

CONTRACTS

(Thousands of Dollars)

	Weekly Feb. 1934	Average Prev. 4 Weeks	Week Feb. 28 1935
Federal Government	$10,091	$2,554	$1,968
State and municipal	12,311	8,800	16,031
Total public	$22,402	$11,354	$17,999
Total private.....	3,663	6,208	4,763
Week's total.....	$26,065	$17,562	$22,762

Cumulative to date:
1934...$262,073,000 1935...$216,353,000

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

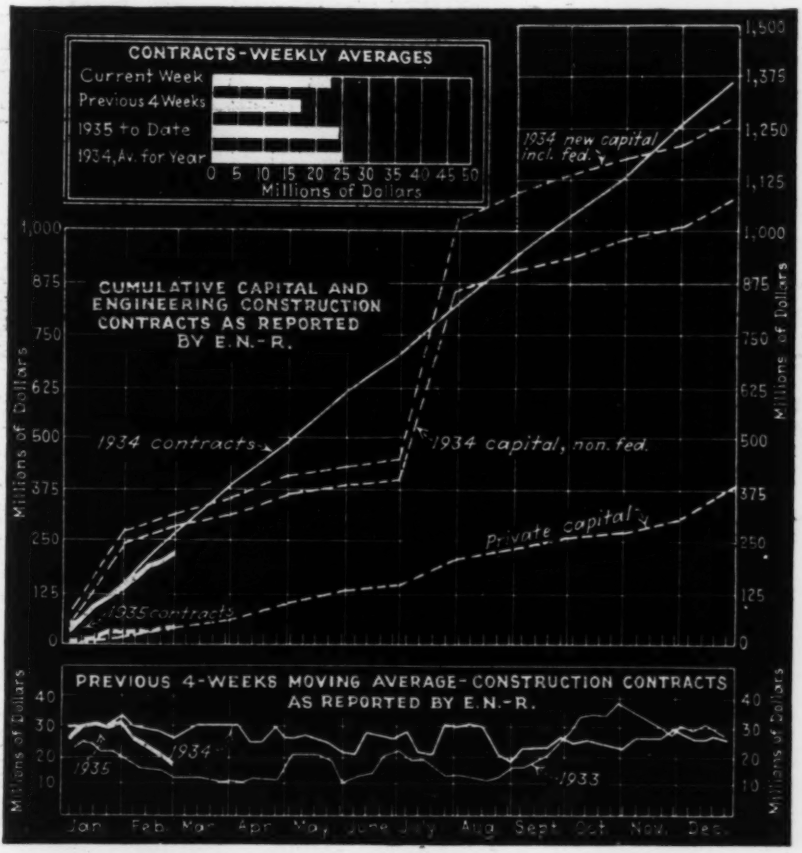
1935	Week Feb. 28	Cumulative
State and municipal.....	$4,360*	$56,719
PWA allotment, S&M..	—7,723*	—32,138
RFC loans, S&M......	....	63
Corporate issues	....	....
PWA allotments, private	3,319	7,279
Total, Non-Federal...	—$44	$31,923
PWA allotments, Federal Constr.	1,434	7,939
Total new capital.....	$1,390	$39,862

Cumulative to date:
1934....$333,748,000 1935....$39,862,000

*Includes $3,035,000 PWA bonds sold by RFC in private investment municipal bond market.

INDEX NUMBER

E.N.-R.-Cost	1913 = 100	1926 = 100	E.N.-R.-Volume	1913 = 100	1926 = 100
Feb., 1935	**196.02**	**94.22**	**Jan., 1935**	**130**	**57**
Jan., 1934	198.72	95.52	Dec., 1934	105	46
Feb., 1934	194.06	93.20	Jan., 1934	149	65
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56



Current Construction Unit Prices

Cost of Hand Trenching of Sewers

AN INTERESTING comparison of the cost of digging sewer trenches by hand and by machine was revealed by bids submitted for *22,625* ft. of sanitary sewers for Solomon, Kans. Alternate bids were asked on six depths of trenches, separated at 2-ft. intervals from 4 to 16 ft. deep. The average of three low bidders for hand trenching was $14,211; for machine work $5,507, or 39 per cent of the cost of hand work; and for hand digging on trenches 4 to 8 ft. in depth and machine trenching over 8 ft., $7,591, or 54 per cent of all hand work. Contract was awarded on Dec. 22, 1934, on the basis of hand excavation on lines under 8 ft. in depth and machine trenching over that depth, to a contractor who bid $11,664 for hand work, $4,813 for machine and $7,604 for the combination, these prices being for excavation of trench only. Cost of pipe and other work involved brought the contract price up to $26,885. Eleven bids were submitted, ranging from $24,112 for all machine excavation to $39,376 for all hand work. The Wilson Engineering Co., Salina, Kan., is consulting engineer. Following are tables showing complete unit prices of the three lowest bidders with a breakdown of hand and machine and combination excavation totals:

THREE LOW BIDDERS AND TOTAL OF BIDS
SOLOMON, KANS., SEWERS

	Excav. only	Total Bid
A—P. P. Young, St. Joseph, Mo.:		
All hand trenching	$11,664	$30,994
All machine trenching	4,813	24,094
Combination hand and machine (contract)	7,604	26,885
B—H. J. Taylor Const. Co., Salina, Kans.:		
All hand trenching	17,989	37,297
All machine trenching	7,061	26,352
Combination hand and machine	7,665	26,955
C—C. L. Burt Const. Co., Hutchinson, Kans.:		
All hand trenching	12,979	32,901
All machine trenching	4,646	24,568
Combination hand and machine	7,405	27,327

UNIT PRICES, SOLOMON, KANS., SANITARY SEWERS

Item and Quantity	Unit Prices A	B	C
I—Trenching and backfilling by hand:			
1. 4 to 6 ft. deep—4,175 l.f.	$0.29	$0.25	$0.30
2. 6 to 8 ft. deep—7,900 l.f.	.39	.30	.45
3. 8 to 10 ft. deep—4,825 l.f.	.53	1.00	.60
4. 10 to 12 ft. deep—3,800 l.f.	.73	1.50	.80
5. 12 to 14 ft. deep—1,525 l.f.	1.02	2.00	1.10
6. 14 to 16 ft. deep—400 l.f.	1.29	2.50	1.40
IA—Alternate, machine trenching:			
1. 4 to 6 ft. deep—4,175 l.f.	.11	.20	.15
2. 6 to 8 ft. deep—7,900 l.f.	.13	.25	.18
3. 8 to 10 ft. deep—4,825 ft.	.21	.35	.21
4. 10 to 12 ft. deep—3,800 l.f.	.35	.40	.25
5. 12 to 14 ft. deep—1,525 l.f.	.47	.50	.30
6. 14 to 16 ft. deep—400 l.f.	.62	.70	.40
II—Cut and replace pavement—100 l.f.	1.35	2.40	1.50
III—Vitrified clay pipe in place:			
1. 8-in. pipe—20,400 l.f.	.47	.43	.50
2. 8 x 6-in. wye—600 each	.80	.72	.75
3. 10-in. pipe—400 l.f.	.64	.58	.60
4. 10 x 6-in. wye—2 each	1.15	1.20	1.00
5. 12-in. pipe—1,900 l.f.	.81	.73	.75
6. 12 x 6-in. wye—10 each	1.60	1.80	1.25
IV—Manholes in place:			
1. Std. brick, 6 ft. deep—37 each	56.00	42.00	55.00
2. Std. brick drop manhole—4 each	62.00	55.00	70.00
3. Extra manhole depth—140 ft.	6.65	5.00	6.00
V—Flush tanks:			
1. Standard flush tank complete—15 each	105.00	120.00	90.00
2. Extra flush tank depth—6 ft.	6.65	5.50	6.00
3. Gal. steel water supply in place—1,000 l.f.	.42	.30	.30
VI—Complete creek crossing—1 only	108.00	200.00	200.00
VII—Railroad crossings:			
1. U. P. R. R.—1 only	1,225.00	2,000.00	1,500.00
2. A. T. & S. F. R. R.—1 only	410.00	800.00	500.00
VIII—Complete outfall structure	295.00	600.00	400.00

Electric Distribution System, Knoxville, Tenn.

THE CITY of Knoxville, Tenn., on Jan. 9, 1935, awarded the first contract for the construction of a municipal-owned electric distribution system for the use of TVA power. This contract will cover about one-fourth of the city's area. The bids were originally submitted in July, 1934, but action was deferred to await the outcome of the proposed purchase of the existing system owned by the Tennessee Public Service Co. It is expected bids will be asked soon for the remaining sections not included in the

ELECTRIC DISTRIBUTION SYSTEM, KNOXVILLE, TENN.

Miscellaneous Items	A	B	C
14. Anchor in rock	$3.05	$9.56	$7.25
15. Guy Protectors	2.05	1.58	1.79
16. Rock excav. for poles and anchors, cu. ft.	.98	.85	.71
17. Class B pole, concrete, cu. ft.	.63	.90	.51
18. Grounds in place, each	5.06	2.76	5.15
19. Service ground connection	1.55	11.25	1.59
20. Pin type insulator and steel pin, 4 KV	.75	.63	.73
21. Do. 13.2 KV	1.16	.96	1.07
22. Screw pin and insulator, 4 KV	.37	.37	.47
23. Dead end insulator assembly, 13.2 KV	4.79	4.78	4.46
24. Do. 4 KV	1.94	1.30	1.82
25. Secondary dead end insulator assembly	1.12	.68	1.22
26. Underground cable (per 100 ft.)	15.87	42.00	22.40
27. Riser pipe, each	8.25	10.50	18.40
28. 20 kw. constant current trans. (each)	616.40	650.00	615.30
29. 15 kw. constant current trans. (each)	541.65	555.00	541.95
30. D. P. S. T. pole type switch	110.40	120.00	122.10
31. Time switch	38.41	55.00	50.15
32. Manhole, racks, hangers, (each)	365.70	400.00	417.00
33. 250 MCM, 4 cond. 5,000 V. P. & L. cable (100 ft.)	190.90	195.00	193.15
34. 1–0, 3 cond. 15,000 V. P. & L. cable (100 ft.)	105.80	130.00	137.20
35. 250 MCM, 4 cond. 5 KV, st. splice, each	26.91	35.50	25.60
36. 1–0, 3 cond. 15 KV, st. splice, each	39.33	50.00	35.45
37. Fire proofing, lin. ft.	.57	.75	1.60
38. Terminal pole assembly, one 4 KV and one 13.2 KV	287.27	385.00	364.80
39. Do. for two 4 KV, each	208.15	295.00	284.00
40. Do. for two 13.2 KV, each	339.00	410.00	440.00
41. Terminal pole for one 4 KV circuit	117.30	150.00	152.00
42. Terminal pole for one 13.2 KV circuit	157.55	175.00	227.00
43. Unload and warehouse transformers, 3 KVA, 2300 V. trans. inc. arresters and cutouts, each	.30	.85	.65
44. 5 KVA, Do.	.37	.85	.65
45. 7½ KVA, Do.	.42	.90	.65
46. 10 KVA, Do.	.49	.90	1.00
47. 15 KVA, Do.	.71	1.00	1.00
48. 25 KVA, Do.	1.33	1.00	2.00
49. 37½ KVA, Do.	2.02	1.25	2.00
50. 50 KVA, Do.	3.10	1.25	2.00
51. 75 KVA, Do.	4.49	3.00	3.30
52. 13,200 V. trans. as item 43, 25 KVA	3.00	1.10	2.00
53. 37½ KVA, Do.	3.74	1.35	2.00
54. 50 KVA, Do.	$4.60	$1.35	$2.00
55. 75 KVA, Do.	5.75	5.00	3.30
56. 100 KVA, Do.	8.05	10.00	3.30
57. 200 KVA, Do.	10.35	20.00	7.95
58. 250 KVA, Do.	13.23	25.00	19.90
59. 333 KVA, Do.	16.67	35.00	33.20
60. 500 KVA, Do.	20.70	50.00	66.40
61. 1000 KVA, Do.	27.05	100.00	99.60
62. Transformer platform, in place, 2300 V, 37½–100 KVA	37.50	45.00	25.70
63. Do. 13,200 V, 25–100 KVA	45.00	50.00	44.80
64. Arresters, in place, 2300 V, line type	8.17	8.50	8.45
65. Do. station type	416.30	285.00	255.35
66. Do. 13,200 V, line type	21.28	25.00	25.30
67. Do. 13,200 V, station type	610.65	465.00	451.00
68. 13,200 V, cutouts in place, expulsion fused switches	17.48	20.00	17.55
69. Meter installation, City furnishes, single phase 5 amp. 115 V, 2 wire	.52	.40	1.35
70. Do. 10 amp., 115 V, 2 wire	.59	.40	1.35
71. Do. 15 amp., 115 V, 2 wire	.59	.75	1.35
72. Do. 25 amp., 115 V, 2 wire	.66	.80	1.35
73. Do. 50 amp., 115 V, 2 wire	.69	.95	1.35
74. Do. 5 amp., 230 V, 3 wire, 1 ph.	.76	.45	1.45
75. Do. 10 amp.	.76	.45	1.45
76. As item 74, 15 amp.	.88	.85	1.45
77. As item 74, 25 amp.	.88	.90	1.45
78. As item 74, 50 amp.	.92	1.25	1.45
79. Polyphase, two element meters, 5 amps	.64	.75	1.65
80. Do. 10 amps	.64	.75	1.65
81. Do. 15 amps	.87	1.15	1.65
82. Do. 25 amps	1.11	1.15	1.65
83. Do. 50 amps	2.10	1.50	1.65
84. Polyphase, three element meters, 5 amps	.69	1.00	2.00
85. Do. 10 amps	.69	1.00	2.00
86. Do. 15 amps	.88	1.10	2.00
87. Do. 25 amps	1.26	1.10	2.00
88. Do. 50 amps	1.50	2.00	2.00
89. Current transformers, 440 V or less	1.56	2.50	5.90
90. As item 89, 2300 volts	2.71	2.50	5.90
91. Potential transformers, 440 V or less	1.56	1.00	5.90
92. As item 91, for 2300 volts	2.50	1.00	5.90

present contract. Five proposals were submitted, ranging from $197,575 to $362,931. The following tabulation shows complete unit bids of the three low bidders. (A) Hess & Barton, Pittsburgh (contract), $197,575; (B) Monroe Electric Co., Chicago, $199,950; (C) G. L. Tarlton, St. Louis, $209,650. H. H. Hale is engineer.

ELECTRIC DISTRIBUTION SYSTEM, KNOXVILLE, TENN. (Cont'd)

Item	Conventional Type incldg. Arresters and Cutouts Bidders			Unit Mounted or Surge proof Type with Cutouts Bidders			Surge proof, completely protected Type Bidders		
1. Transfer Installation 2300—115/230 V. Single Ph. (City Furnishes).	A	B	C	A	B	C	A	B	C
3 KVA	$3.40	$3.50	$7.20	$3.05	$3.00	$6.60	$3.90	$3.00	$5.90
5 KVA	4.08	5.65	7.50	3.73	4.70	6.90	3.55	4.70	6.20
7½ KVA	4.35	8.50	9.65	4.00	7.00	9.00	3.80	5.75	8.20
10 KVA	5.01	11.25	9.95	4.65	9.75	9.30	4.48	9.50	8.50
15 KVA	5.75	14.10	10.30	5.35	12.60	9.63	5.10	12.25	8.80
25 KVA	6.79	20.00	13.40	6.44	18.50	12.75	6.20	18.00	11.75
37½ KVA	9.61	27.50	15.25	9.25	26.00	14.60	9.00	25.00	13.60
50 KVA	10.64	35.00	31.10	10.25	32.00	30.30	10.00	30.00	28.70
75 KVA	13.98	56.25	56.50	13.60	53.00	55.00	13.20	50.00	51.00
100 KVA	11.50	75.00	85.00	11.00	72.50	84.00	10.75	70.00	81.00
2. 13,200 V. Single Ph. (City Furnishes)	Single Phase Installation			Banks of Three			Deduct from Bank of Three for One Omitted		
25 KVA	9.54	22.50	95.00	25.30	60.00	167.50	6.90	45.00	15.90
37½ KVA	14.49	30.00	96.50	36.80	90.00	171.00	9.20	60.00	15.90
50 KVA	17.25	40.00	103.24	46.00	120.00	187.85	12.65	80.00	19.90
75 KVA	21.04	60.00	113.60	52.90	180.00	211.50	14.38	120.00	26.55
100 KVA	18.98	80.00	123.95	48.30	240.00	236.35	13.23	160.00	33.20
150 KVA	......	......	......	69.00	250.00	216.45	17.25	175.00	26.55
200 KVA	......	......	......	86.25	275.00	236.35	23.00	190.00	33.20
250 KVA	......	......	......	92.00	300.00	276.20	24.15	210.00	46.45
333 KVA	......	......	......	120.75	350.00	316.05	32.20	225.00	59.75
500 KVA	......	......	......	155.25	375.00	454.20	41.40	250.00	99.60
1000 KVA	......	......	......	212.95	400.00	584.85	62.68	300.00	132.65
3. Disconnect switches in place.	4 KV 5 PST Hook Operated			13.2-KV 3 PST Gang Operated 200-Amp. Rating			13.2-KV 3 PST Gang Operated 400-Amp. Rating		
	29.60	40.00	12.60	128.80	135.00	157.55	248.40	260.00	289.35
4. Services complete in place, each.	2 Wire			3 Wire			4 Wire		
No. 0	......	......	......	14.67	19.50	32.90	19.55	25.50	43.65
No. 2-0	......	......	......	18.69	21.50	39.15	25.02	28.50	51.70
No. 2	......	......	......	10.93	12.50	27.60	13.80	16.50	34.60
No. 4	6.04	6.00	12.20	8.57	9.25	18.20	12.08	12.50	22.35
No. 6	5.33	5.50	10.15	7.71	8.75	12.35	11.61	9.75	16.45
No. 8	4.75	5.35	7.10	......	......	......	......	......	......
5. Street lighting equipment, in place. Overhead Mast Arm Units.	2500 Lumen Lamp			4000 Lumen Lamp			6000 Lumen Lamp		
10-ft. arm	33.99	34.50	34.85	34.50	35.00	35.15	35.19	35.50	35.80
14-ft. arm	36.21	36.50	39.60	36.80	37.00	39.60	37.49	37.50	40.85
6. Fibre conduit line (100 ft. units)—4½ in. complete in place.	2 Way			4 Way			6 Way		
	117.00	170.00	190.00	230.00	250.00	335.00	345.00	350.00	480.00
7. Yellow pine poles in place.	Class 2			Class 3			Class 4		
20 ft	11.85	9.25	10.11	10.52	8.05	8.93	9.81	6.15	7.16
25 ft	13.63	9.70	11.35	12.59	8.53	10.03	11.55	7.75	9.15
30 ft	18.28	12.62	14.35	16.79	10.70	12.61	15.46	9.47	9.18
35 ft	23.64	16.25	19.10	20.60	13.78	17.15	18.23	11.87	12.58
40 ft	29.79	19.59	23.10	26.51	16.57	20.69	23.18	14.48	15.26
45 ft	32.43	23.14	28.46	28.52	19.45	25.40	26.17	17.27	19.27
50 ft	37.55	26.68	33.35	34.04	22.36	29.47	......	......	......
55 ft	44.97	29.79	39.80	41.40	27.63	35.19	......	......	......
60 ft	51.47	33.73	44.88	48.30	29.61	40.18	......	......	......
65 ft	67.39	38.50	53.23	......	......	......	......	......	......
70 ft	77.74	45.50	59.80	......	......	......	......	......	......
	3 Spool Light Secondary			3 Spool Heavy Secondary			4 Spool Heavy Secondary		
8. Racks, complete in place, each	1.80	1.41	1.74	2.34	1.97	2.34	2.97	2.70	3.08
9. Cut and repair for pole setting or anchor	Sidewalk per Sq. Ft.			Curbing per Lin. Ft.			Pavement per Sq. Ft.		
	.37	.45	.51	.90	.56	1.33	.63	3.60	1.15
10. Anchors in place 3 way expanding log anchor	8 Inch			10 Inch			6 x 12 Inches		
	4.80	4.45	3.88	8.60	8.16	8.03	......	......	......
	......	......	......	......	......	......	11.13	14.60	18.00

Item	Cross Arm Single			Alley Arm Single			Cross Arm Double			Alley Arm Double		
	A	B	C	A	B	C	A	B	C	A	B	C
11. Cross arms in place												
2 pin 3½" x 4½" x 3½"	2.19	1.75	1.62	2.99	1.95	1.38	4.77	4.05	3.52	5.98	4.50	2.74
4 pin 3½" x 4½" x 5′ 7″	2.53	2.25	1.89	3.80	2.50	2.82	5.41	4.84	4.07	7.36	5.35	5.62
6 pin 3½" x 4½" x 8′ 0″	2.83	2.81	2.16	4.14	3.15	3.10	5.96	5.68	4.61	8.05	6.24	6.17
8 pin 3½" x 4½" x 10′ 0″	3.20	3.50	3.32	4.66	3.85	4.00	6.74	7.35	6.94	10.35	8.05	8.01
2 pin 3¾" x 4¾" x 7′ 0″	3.68	4.10	2.91	4.33	4.55	3.22	7.94	8.75	6.03	8.35	9.75	6.32
4 pin 3¾" x 4¾" x 10′ 0″	4.35	4.90	3.63	4.88	5.50	4.32	9.15	9.00	7.47	9.66	10.00	8.53
12. Wire, complete in place, per 1,000 ft.	MHD TBWF Solid Copper			MHD TBWF Stranded Copper			Hard Drawn Bare Solid			MHD Three Wire		
No. 2	65.78	59.85	59.50	......	......	......	42.77	41.50	41.10	155.25	179.15	161.00
No. 4	45.89	40.05	39.40	......	......	......	26.81	30.25	27.60	117.30	142.00	132.00
No. 6	29.04	29.85	28.50	......	......	......	......	......	......	92.00	153.40	100.00
No. 1-0	.....	.....	.....	107.28	94.45	97.50	69.35*	66.00*	67.60*	230.00	261.50	211.40
No. 2-0	.....	.....	.....	132.06	115.40	120.00	......	......	......	......	......	......
No. 4-0	.....	.....	.....	197.80	170.50	184.00	142.68*	125.00*	134.25*	......	......	......
13. Guys and anchors in place, each.	Std. Steel Head Guy			Std. Steel Down Guy			Siemens-Martin Hd. Guy			Siemens-Martin Down Guy		
⅜" in line	9.58	8.55	8.95	......	......	......	......	......	......	......	......	......
⅜" to stub	8.26	6.30	5.68	......	......	......	......	......	......	......	......	......
½" in line	13.00	10.13	12.10	......	......	......	14.38	10.58	13.80	......	......	......
½" to stub	9.72	7.26	7.35	......	......	......	10.87	7.48	7.97	......	......	......
⅜" (4 KV or less)	.....	.....	.....	5.81	4.67	4.60	......	......	......	......	......	......
½" (4 KV or less)	.....	.....	.....	7.36	5.34	5.96	......	......	......	8.00	5.51	6.55
⅜" (13.2 KV)	.....	.....	.....	6.90	5.96	6.38	......	......	......	......	......	......
½" (13.2 KV)	.....	.....	.....	8.69	6.70	8.57	......	......	......	9.15	6.86	9.35
⅜" std. steel arm guy	10.65	5.63	8.53	......	......	......	......	......	......	......	......	......

* Stranded wire.

Construction Equipment and Materials

New Fire Hydrant

The "Western" fire hydrant has been announced by the Western Gas Construction division of the Koppers Construction Co., Fort Wayne, Ind. The manufacturer states that among the features of the hydrant are a ball thrust bearing operating unit, streamlined openings and large passageways to provide a maximum water flow at a minimum pressure loss, and a large drainage area consisting of nine openings around the periphery of the bronze stationary seat ring.

Western fire hydrant

The hydrant is built in accordance with A.W.W.A. specifications and is available in 4 in., 4½ in., 5 in. and 6 in. sizes.

New Concrete Breaker For Trailer Mounting

The Concrete Cutting Corporation, Brooklyn, N. Y., announces a trailer-type concrete breaking machine to meet the needs of utility companies municipalities and contractors. The maker claims that it reduces the cost of concrete breaking to a minimum. It will increase the output of yardage of a compressor three to ten times.

This machine is light in weight, sturdily built, well balanced on its axles and very mobile.

It can be trailed behind any truck-mounted compressor or handled by hand in breaking out floors in buildings. It has a horizontal movement of 6 ft. and will cut a width from 6 in. to 6 ft. wide. The hammer is suspended in two journals, allowing the operator to move the hammer ahead or back in order to gage the cut. It is controlled entirely from the rear seat, reuiring only two men to operate it. A compressor having a capacity of 160 cu.ft. of air per minute will handle it.

Business Notes

INDEPENDENT PNEUMATIC TOOL Co., Chicago, Ill., announces that A. H. Skaer has been placed in charge of the Cochise Rock Drill Manufacturing Co., Los Angeles, Calif., a subsidiary.

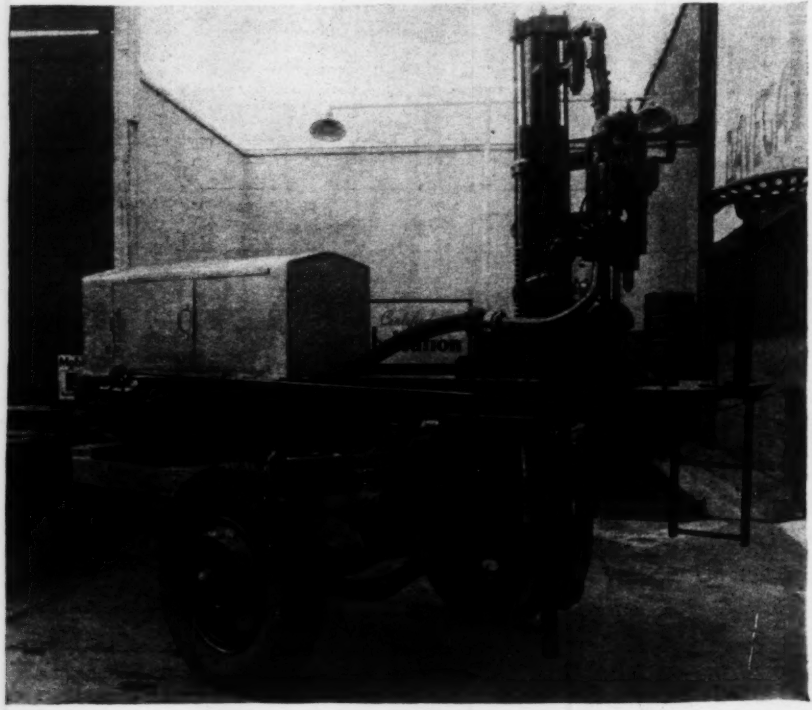
UNIVERSAL FORM CLAMP Co., Chicago, Ill., announces that it has opened Pacific Coast office at San Francisco.

UNIVERSAL ATLAS CEMENT Co. announces the appointment of A. O. Stark as sales manager of the New York district.

PENNSYLVANIA-DIXIE CEMENT CORPORATION, New York, N. Y., announces the appointment of Paul J. Rutan as district sales manager of the Rochester, New York, office.

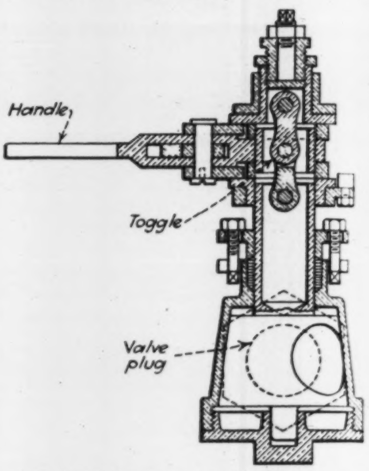
AMERICAN STEEL & WIRE Co. announces that C. F. Hood, manager of the Worcester, Mass., district, has been elected vice-president of the company in charge of operations at its main office in Cleveland, Ohio. He succeeds J. L. Perry, who has been made president of the Tennessee Coal & Iron Co., Birmingham, Ala. Carl I. Collins, superintendent of the Cuyahoga Works of the company at Cleveland, has been appointed manager at Worcester.

Trailer-type concrete breaking machine



Lever-Operated Plug Valve Seats Tight in Open Position

A new lever-operated valve of the plug type, in which the valve seats itself tight in both open and closed positions, is announced by the Golden-Anderson Valve Specialty Co., Pittsburgh, Pa. The valve is designed to unseat axially each time before it is rotated to either open or closed position.



Golden-Anderson Thru-Flow plug valve

The accompanying illustration shows the plug valve unseated and being rotated to open position. As the hand lever approaches the full-open position its course is controlled by a roller so that the toggle link is broken and the plug is drawn up tight in its seat.

The valve is furnished in two-way, three-way and four-way designs of bronze, iron, steel or other metals, according to the service conditions and requirements; and is available in screwed and flanged ends in one-half-inch diameter and larger for all service pressures.

New Equipment in Brief

Concrete Vibrator. A new immersion-type air-driven concrete vibrator has been introduced by Munsell Concrete Vibrators, Jersey City, N. J. The vibrator unit is 5 in. in diameter at the largest cross-section. It is equipped with a ¾ in. air line which is placed inside a 2½ in. hose exhaust line. The overall length of the vibrator is 6 ft.

Splash-Proof Motor. Century Electric Co., St. Louis, Mo., announces a new line of splash-proof slip-ring polyphase motors, suitable for outdoor installation. The motor is constructed with baffled openings in the lower part of the end bracket to admit cooling air and exclude splashing water.

Explosives. A new blasting material for use in quarries and in other blasting operations such as stripping, has been announced by the E. I. DuPont de Nemours & Co., Inc., Wilmington, Del. The new product is known as Nitramon and is marketed only in large diameters, 4 in. and greater. In use it is exploded by a large dynamite cartridge. It cannot be detonated by commercial blasting cap, by impact, or by flame.